Motor Truck Operation and Accounting—83

MOTOR TRUCK REPLACEMENT POLICY

The policy of the Nevada State Highway Department with respect to the replacement of used motor vehicles was stated in the June issue of this magazine. This is a very timely subject inasmuch as many of the motor trucks turned over to state highway departments by the federal government were used machines and many of these have undoubtedly outlived their economic usefulness. Commenting on this point the Nevada Department said: "Oftentimes the used machinery is good for about one season's use; then to repair and keep it in running condition is more expensive than to replace with new equipment." The general replacement policy of the Nevada Department is stated as follows: "We find that when the salvage value of a machine equals one-fourth of its original cost, and its repair to usable condition equals one-half its original cost, with continued operating costs about double that of a new machine, it is good business to turn the machine in on a new one."

Believing that this question is one of prime interest and importance we invited several men in the motor industry, in whose judgment we have great confidence, to comment on the general proposition with special reference to Nevada procedure. Extracts from their letters are quoted herewith.

"Motor truck replacement policies of the state and municipal highway departments must naturally be planned and carried out from a business standpoint. In this respect our governments can be no different from individuals.

"Trucks that are properly taken care of and for which parts can be secured immediately and at reasonable rates naturally have a much longer economical life than trucks which have not been kept in good condition and varieties which cannot be serviced properly in the districts in which they are located. The date on which a truck should be replaced can only be determined by its condition and the cost of maintaining it at full efficiency. It is going to vary with the individual trucks, the work they are called upon to do, and the care that is given them. That is about all that any manufacturer can say in regard to a motor truck without having a careful inspection made of each truck under consideration."

Commenting on the need for a well-considered replacement policy, another correspondent writes:

"Without doubt there will be a strong temptation on the part of highway officials of many states to keep down expenditures because of fear of incurring the displeasure of taxpayers, and at least some of these officials will carry the thing too far and actually spend more of the taxpayers' money for repairs to keep the old truck going, and then have nothing but a badly worn truck, than up-to-date machinery would cost."

That the economic life of the motor truck is much longer than the period usually assumed is the central idea in a letter from another authority. He writes:

"Having built only high grade motor trucks for over 20 years, we ourselves are not at all disposed to agree that any well engineered and built motor truck should be amortized in three to five years, as stated in the article on Nevada practice.

"Rather we claim that there are trucks so well engineered and built these days that if rationally operated and given reasonable care and mechanical attention, they should not, in fact will not, be worn out in any three to five years, but will instead be good and economical operating units in eight to ten years from the present time, and it has been our policy to preach the gospel of reasonable use and care with its resulting longer life and lower ton mile cost to the owner, instead of cheap quality and frequent truck turn over.

"The writer knows of no other line of machinery of any kind whatever, (unless it is for farmers' use, which is uniformly of very much different character and quality than motor trucks) in which there is any thought on the part of the purchaser that he will amortize any unit that costs as much as does a truck, in three to five years. Instead you will find that all kinds of machinery in thoroughly high grade shops run twice and even three times the length of time stated and are doing thoroughly good work. About the only exception that the writer can

think of to that general statement would be where high precision operations would be required, which demand a more frequent renewal of tool equipment.

"We can say to you frankly that we have out, not dozens, but hundreds of motor trucks operating now that were built as far back as 1910-1912-1913-1914. In fact, we are servicing such trucks all the time out of our present service stock which only goes to prove that the statement we have made is a correct one.

"To our way of thinking, first purchase price should cut no figure. Instead, the prospective buyer in his own interests should endeavor accurately to ascertain what will be his average annual ton-mile cost for transportation, figured over a period of six to ten years; such costs to include not only purchase price but operation, up-keep and annual amortization, together with loss sustained by lay-up of a truck and the inability regularly to carry on a man's business."

Another careful student of highway truck problems writes:

"There probably will be a temptation for state authorities to use motor equipment beyond the limit of its economic existence. This will probably be especially true of trucks received from the federal government. This would be perfectly natural, as having received these trucks with but a small item of expense, they have had the use of the trucks without incurring a large first cost and they will probably be disposed to continue the use of these trucks long past their period of economic use, rather than to involve the departments in the purchase of new equipment.

"The policy proposed by the Nevada State Highway Department seems like a very reasonable one. When a truck has depreciated to such an extent that its value is not to exceed one-fourth of the original cost and the expense of rehabilitating it is equal to one-half of the cost of the truck, I would say that the state would be amply justified in getting rid of that equipment to the best advantage and replacing it with new. In this connection three contingencies are possible:

"1. The truck may be sold for junk and new trucks purchased outright.

"2. It may be used in trade-in for new trucks.

"3. It may be dismantled in order to secure from it, for spare parts, such portions as may be available for that purpose.

"The state highway authorities are not only justified, but are in duty bound, to adopt such methods of disposal as would be for the best interests of the State Department. Just what course that will be may differ in different states and under varying conditions. This much is undoubtedly true that long before the highway construction plans now proposed are carried to completion the trucks granted to the states, and often by them to the counties, will have been worn out and new equipment of truck will be necessary.

"In securing that new equipment the State Highway Department should be guided by very much the same principles which direct the action of the commercial purchaser of trucks. They will have had a considerable amount of experience with motor trucks, should have learned how to operate them effectively and should have formulated some fairly definite opinions as to what trucks are best adapted for highway work and also should have learned from experience where they can expect most satisfactory service on their truck equipment. These considerations should direct them, it seems to the writer, in timing their purchases, in determining the manner of purchase, as well as the line or lines of motor trucks which they may select."

Additional comment on this important subject is invited for publication.

NEVADA PUBLIC SERVICE COMMISSION RENDERS GRADE-CROSSING DECISION

On April 25, 1922, on the application of the Nevada State Highway Department the Public Service Commission held a hearing on the matter of elimination of railroad grade-crossings on the state highway system. All rail carriers in Nevada and the Highway Department were represented at this hearing, and evidence introduced by both parties placed before the commission for the purpose of securing an opinion fixing a uniform rate of participation for the carriers on grade-crossing elimination. On June 14 the commission rendered its opinion on this matter, fixing a uniform rate for the carriers of not less than 33 1/3 per cent of the total cost of elimination, each case to receive special consideration. The following are significant paragraphs taken from the commission's opinion:

"The present state highway plans will be completed in about ten years, and

crossing separation will generally be made only as the development reaches the various tracks, this work being done in connection with the surfacing of the road in the locality. The number of crossings involved is not definitely known, as some of them have not yet been reached for intensive study, but the best figure now available is 52, and the elimination of some of these may be found unnecessary or impracticable. The separation of 52 crossings during the 10-year construction program means an average of barely 5 per year in the entire state. The proposed crossings appear to be pretty well distributed throughout the state, and would not seem to impose a serious burden on any one line.

"It is suggested by the carriers that the large appropriation made by the Federal government, on account of the great area of government land in this state which pays no taxes, should reduce the proportion to be paid by the railroads; that they should participate only in the portion of expense not borne by the nation. It seems, however, that it would make little difference to the carriers who pays the sum which is not assessed against them, whether it be the nation, the state, or a county, and this argument seems to be of little force.

"They complain that the state and national highway construction program is of no benefit to them; that in fact it will be detrimental because it will afford a competitive route for private and public automobile transportation; that, through the property taxes paid, their participation in the cost of highway construction and maintenance is heavy and that it goes to the benefit of their competitors. We must keep in view, however, that, in so far as automobile transportation results in an improvement in the art of rendering service, the public is entitled to the benefits thereof, subject to adequate regulation and taxation of these instrumentalities. On the other hand, the enlarged freight and passenger traffic and revenues flowing to the railroads from the enlarged use of auto-truck and stage lines is not of record, and, while it cannot be estimated at this time, the assumption is that these transportation agencies will give to the railroads as much or more revenue than they have taken from them, provided, however, that reasonable regulation is made against the paralleling of short-line railroads where the population and the traffic are small and the latter is necessary for the support of the railroad.

"It is not entirely clear whether the railroads consider a proportion of 12½ per cent or of 25 per cent reasonable, but in the absence of precedent, and on the record as it stands, we believe either of these sums too small. It is argued that the only method of assessing costs which would be fair to the railroad is to capitalize the expense of grade crossings, taking as a basis the amounts paid by the several carriers as damages for crossing accidents. There might possibly be some merit to this suggestion if we could know that the experiences of the past would be a fair guide to the future, but a crossing where there has never has been an accident may at any time be the scene of a collision attended with serious loss of life, causing the railroad to be involved in litigation resulting in the payment of large damage claims.

"It is impossible to foretell the monetary damage that may be saved a railroad by the elimination of any particular grade crossing. Aside from this, loss of life cannot be computed in dollars and cents, and the railroad owes a duty to the public which cannot be measured by or based upon a medium of exchange. It is suggested that the so-called "humanitarian" duty of the railroad is taken care of by its contribution to the general fund of the state through taxation, and that in this respect it stands on the same footing as any other citizen. This might be true were it not for the fact that the very element of danger which requires the separation of crossings has been incurred by the railroads in building and operating their lines over and along the public highways. One engaged in a hazardous occupation must provide for the safety of the general public and must, as a consequence, stand expenses which are not chargeable to all others.

"The question, therefore, goes to 'the safety of the traveling public and to the making of grade-crossing elimination, changes and betterments for the protection of the public and the prevention of accidents effective'; and to this end the exercise of the police power of the state is provided for in section 18a of the Public Service Commission Act (Stats. 1919, page 198).

"The carriers undertake to support their position in this proceeding by the contention that they pay from one-half to two-thirds of the total taxes in certain counties and an average of 38 per cent of all taxes paid by all property in the state. This position is seemingly untenable, for there is no constitutional

power, either national or state, under which an assignment of benefits can be allocated to a given class of property in proportion to the involuntary obligation which has been levied against it for the support of government. To hold otherwise is to say that property shall benefit in the exercise of governmental rights and privileges in proportion to the volume of taxes paid by each class, a wholly un-American classification of property and a restriction of the rights and liberties of individuals under our form of government.

"On the basis of the record before us and for the reasons aforesaid, it is impossible, under our statutes, to fix a hard-and-fast rule applicable to all cases. All that we can hope to do in this case is to establish a uniform rule, subject to variation in any particular case. In fact, it was agreed, at the hearing that it might be well to establish such a general rule "as a starting-point," fixing a percentage that will be fairly applicable to every railroad, whether rich or poor, and to every locality where such crossings may be established.

"In reaching a conclusion, we must accept the suggestion of 50 per cent made by the Highway Department, or find something between that and the 12½ or 25 per cent proposed by the railroads, which, we have already stated, is too low. Considering the financial condition of the state, the help it is receiving from the Federal government, the financial condition of the several railroads in the state, and the mutual value to the state and the railroads of eliminating crossings, after conference between railroad and state highway engineers on a program of construction extending over a period of ten years, and without unreasonable or burdensome capital outlays being required of the railroads in any one year, we are inclined to believe, and so find, that a participation of the railroads in the cost of eliminating grade crossings upon the state highway system to the extent of 33 1/3 per cent of the entire cost should be fair and equitable to all concerned, with the understanding that a variation of this percentage may be made in any particular case where the circumstances seem to justify a different finding. No order will be necessary herein."

ROAD SURFACES AND TIRE COST

"In the State of California," says the Richland, Wash., Advocate, "there are some 600,000 automobiles licensed. It is safe to say that the average machine, including trucks and pleasure cars, expends $100 each year for tires or an aggregate of $60,000,000 annually in this one state.

"It is safe to say that the annual depreciation on these tires is 20 per cent greater on a rough or gritty surfaced highway than it would be if such surface were covered with a cushion of some bituminous substance which not only would protect the foundation of the road but take the grind off the tires.

"In the one state of California this would mean a saving of $12,000,000 annually to automobile users for tires alone not to mention the saving to taxpayers through the longer life which would result to their permanent highways.

"Ten years hence, after various states have experienced the costly experiment of leaving the surface of their permanent highways unprotected by a non-jarring surface, public sentiment will be unanimous for that character of construction regardless of material used for the road base."

SOME COMMON INTERESTS OF HIGHWAY AND RAIL TRANSPORTATION

By Zenas W. Carter, The White Co., Cleveland, Ohio

(Editor's Note: That the highway, electric and steam rail lines have much in common is clearly set forth in this valuable paper by Mr. Carter, recently presented before the Central Electric Railway Association.)

A mighty wave of desire to "ride on rubber" has been sweeping the United States during the past few years. It seems fitting to call this desire of the public a "rubber urge" in transportation.

Just what the psychology is back of this wave, which is constantly increasing its size, is of less interest to the electric railway operator than the question of this influence upon his daily problem.

The electric railway operator is in the transportation business. He uses steel rails and electricity as his work tools. Theoretically he is interested only in steel rail and electricity.

Commercially and practically, however, he is in the transportation business, and the "rubber urge" is a feature of the transportation business. It affects both freight and passenger business. Motor

trucks and busses are here to stay. Their use is rapidly increasing everywhere and on every highway. They are essentially and actively an important part of the transportation business of today.

Thus, as a transportation man the electric railway operator finds his attention centering more and more upon the problem of co-ordinating motor trucks and motor busses with his electrical operation.

Just how this may be done to best cater to public demand to "ride on rubber" is an individual problem in each particular case. No general rule can be set up which will fit any two cases.

However, this much can be stated most emphatically—motor trucks and motor busses must represent an ultimate economy or they are a distinct liability.

Use of Motor Trucks and Busses by Electric Railways

This question of the economy of motor trucks and motor busses when used by electric railway companies has too many factors for any one to offer much more than a statement of some of the operations already underway. For instance, six months ago an officer of one of the Ohio electric railway companies made the statement that they were not interested in motor busses. At the present time this same company has determined that it will be economical for them to purchase (and their order has been placed) five special motor busses. These are to be operated on a highway paralleling their present lines.

Their decision was made from two angles entirely uninfluenced by the question of direct profit. In the first place, if they had not initiated bus operation covering the territory someone else would have started this service. Their franchise was in jeopardy because the public in the territory were not adequately served by the present electric service. Another factor was lack of capital to make the electric extensions, and their belief that the cost of additional track laying and equipment would be too great to prove a profitable investment at the established rate of fare.

Another company, the Northern Ohio Traction Company of Akron found, by careful study and survey, that there was an opportunity to keep competition from their electric lines and at the same time operate busses at a profit by initiating two bus lines, generally paralleling their trolley service at a distance of several blocks off track. On one of these lines there was already partial jitney competition, but this competition will soon be entirely eliminated by the action of the trolley company in purchasing high-class motor bus equipment and by their granting transfers from bus lines to the trolley cars.

An important factor in both these cases is also the opportunity offered by motor bus use to test the volume of traffic which may be secured, in advance of making an expensive installation. Furthermore, should it be necessary later either to abandon the lines or prove more profitable to install electric trolley operation, the motor busses will have a large salvage value or may be at once transferred to other service.

These two cases are cited particularly to illustrate that the question of economics in electric railway operation is not necessarily a question of making a specific profit on a definite installation of motor equipment.

On the other hand, there are hundreds of motor bus lines in operation in the United States in territory which was not being served by either the electric or steam companies. These hundreds of bus lines are delivering a profit to their operators. In some cases, as in California and a few of the Middle West cities, the patronage has already proven so profitable that passenger and transfer stations have been supplied by the bus operators.

Surveying Motor Bus Prospects

It is reasonable to assume that this business belonged to the transportation companies, either the steam or electric operators. As it is in outside hands, it is evident this transportation business was lost to the regular transportation companies largely through lack of interest in their making surveys for motor bus operation.

Several of the larger electric and steam railway companies have, however, checked over their prospective fields and are now actively in the business of catering to the public idea that it desires to "ride on rubber."

At Milwaukee, the Milwaukee Electric Street Railway Company made surveys which have justified their purchasing and operating 20 or more busses in co-ordination with their electric service. This action on their part has enabled them to conserve completely their investment in electric operation and to capitalize the "Rubber Urge" in making their extensions and in supplementing and supporting their normal service. In this way they have met conditions and fully satis-

fied the public demand for additional service.

Among the many street railway companies in the United States who have initiated bus service in co-ordination with their electric property operations are the United Electric Railways Company of Providence, R. I.; the Penn. and Ohio Elec. Ry. Co. of Youngstown, Ohio; the Rockford and Interurban Street Ry. Co., Rockford, Ill.; the Conn. Co., at various places in Connecticut; the Public Service Corporation of Newark, N. J.; the Street Railway Company of Baltimore, Washington, D. C.; Tulsa, Okla., etc.

Several of the New England Companies have already initiated bus service and in California the electric lines are both operating busses as individual companies and in co-operation and in co-ordination with independent bus companies in order to issue through tickets for long trips. At Niagara Falls, the Gorge R. R. Co. supplement their service by a bus operation; the Escanaba (Michigan) Power and Traction Company and the Northern Texas Traction Co. of Ft. Worth are also now on the list of users of both electric and gas motor bus transportation. At San Francisco and Seattle the Municipal companies are co-ordinating both types of service in carrying passengers. As an evidence of the very rapid increase in the use of motor busses throughout the United States and in support of the statement that the public is enthused over the flexibility, convenience, economy and utility of the motor bus, it is most interesting to cite the fact that one manufacturer of busses has received orders for over 350 of a new model which was first announced to the electric railway and motor bus operators on Jan. 1, 1922.

As transportation men, the electric railway operators will undoubtedly be much interested and possibly quite surprised to know that an independent bus operator, Frank Martz, of Plymouth, Pa., carried more passengers per bus in 23 busses which he operated in Wilkes-Barre, Pa., in 1921, than were carried by the same number (23) of the busses operating on the Fifth Avenue line in New York city. The figures are: For Wilkes-Barre, 183,891 passengers per bus, for New York City 174,192 passengers per bus. In fact, the total passengers carried by Mr. Martz in the busses which he operates in Wilkes-Barre, Pa., territory was well in excess of four million passengers carried during 1921. Mr. Martz began hauling passengers in and about Plymouth, Pa., in 1910, and he reports that several of his busses have passed the 300,000 mile travel mark, that 8 have run more than 200,000 miles and that 20 have run more than 100,000 miles each.

Throughout the United States there are dozens of these independent bus operating companies, which have had a period of existence amply justifying the statement that motor bus operation is an economic transportation.

Mention should also be made of the rapidly increasing use of motor busses of special type to transport vacationists, tourists and business men into scenic and resort territory previously inaccessible on account of physical contours of the country and the seasonal feature of the traffic

Some Busses Go North in Summer, South in Winter

Motor busses may be driven over inexpensive highways and into hilly territory serving seasonal traffic and transferred to other territory at will. This frequently makes an operation very profitable through using these busses in service in the North in summer and in the South in winter.

Last year on a trip from Chicago to the Pacific coast the most impressive single feature of the entire distance was the ever-present motor traffic. Whether we went west along the well known routes of travel or toured as we did into the very interior of Utah, in one case going to the north rim of the Grand Canyon 202 miles by highway away from any railroad, there was always motorized traffic passing in both directions, citizens in passenger cars, motor trucks and motor busses.

There were cars from almost every state in the Union, and motor trucks carrying almost everything conceivable from live stock to miscellaneous merchandise. Certainly no one thing could more emphatically demonstrate the fact that we are in the process of motorizing our highways, and that the "rubber" transportation of today is a new economic force in this service.

When we arrived in California the traffic increased tremendously, motor trucks and motor busses operating everywhere in addition to the thousands of passenger cars, further compelling recognition of the value of good roads in this process of motorization.

With the thought in mind that motor vehicles have been in successful operation and on an economic basis for such a short while, at best less than a period of one generation, it is difficult fully to real-

ize the great revolution which has come in our highway transport.

Our steam railway and our electric railway operations have been largely revolutionized during this same period through the development of the several types of motive forces. The application of these same power forces to industry, electricity, steam and gas has changed our entire country from a manual institution into a mechanical institution.

In a measure, motorization of our highways is likewise a change from a manual to a mechanical method of highway transport. Until the advent of the modern motor vehicle there had been very little progress made in the type of road vehicle in use since the days of the Roman road and the Roman horse-drawn chariots. What little progress had been made was merely in the character of the load-carrying device. The motive force was still physical power and not mechanical.

With almost 11,000,000 motor vehicles already on our highways it will be just a short time until all individual highway transport will be by motor.

The Ultimate Return to the Rail Interests

This is the logical step for this generation. It is the absolutely necessary step in the evolution of mankind. The steam railways and the electric railways will reap a return ultimately from this motorization as it will tend still more closely to knit the country into a corporate economic unit to promote quick exchange and rapid interchange.

While at the present moment, in some isolated instances, the advent of the motor truck and the motor bus may seem to initiate a new competitive unit and ultimately there may be members of lines of steam, electric and motor busses serving in the same community—the motorized vehicle will always be used for a type of economic transportation which, in general, is not competitive with either steam or electric operation.

It is an important fact that the motor on the highway offers the opportunity to supply the public with both local and express service operating over the same route, while this is impossible on single line rail.

Paralleling Rail Lines

It is very probable that a great many electric railway companies could profitably operate bus lines paralleling their rails, especially in congested centers, operating the bus lines for express service and using the electric service almost entirely for local stops. In many cities it would be possible to secure 10 ct. fare rates for such improvement in service and thus turn into a very profitable operation a franchise which carried so much long haul traffic as to be otherwise unprofitable at the usual 5 ct. fare rate.

In other cases such a service might solve a rush hour congestion problem profitably where the addition of extra cars would only tend to slow up movement and increase congestion.

Another field for the use of busses, in conjunction with electric line operation, is in territory where development has spread the area served until a large percentage of possible short haul passenger business is lost on account of the distance the passenger must initially walk to reach the trolley.

The use of busses covering such a section over what might be called a curved or bow route paralleling the trolley service at some distance but not operating on exact trolley schedule would often prove distinctly profitable and preserve the existing company from possible competition.

The picking up and delivering at curb, whether in urban or in congested city territory, is a psychological element to consider in the opportunity to increase short haul traffic.

The Lure of the Jitney

As previously stated, an interesting phase of the great increase in the use of the motor bus is that the public has, through ownership of motor cars, been educated to "Ride on Rubber." Probably this, as much as anything else, is the real reason why men, women and children will jam into and overcrowd the "jitney" and seem to prefer it in many cases as a means of transportation, even in places where the "jitney" service is paralleled by the electric railway.

It is largely the people who do not own cars that prefer the "jitney." It seems to be a vehicle of which the rider is more intimately a partner than in the trolley. The psychology of the entire situation is a vital factor. This is the "urge" back of the increasing use of busses.

In the motorization of our highways the motor truck has been ranking next to the passenger car in importance up to the present time, but it is very probable the use of the motor bus will soon exceed even the use of the truck in the revolutionizing of our highway transport.

The Question of Motor Vehicle Taxation

In this, it is very pertinent to comment on the subject of agitation in some sections to have the motor vehicle more heavily taxed.

Fundamentally, this is moving in the wrong direction except in so far as all vehicles using the highways may be taxed in proportion to their proper share of maintenance. As figures given later will show this is already accomplished.

The motorization of our highways is itself the economic force which has compelled the betterment of our highways and to increase taxation of this special class group would seem to tend to drive backward instead of forward.

While the motor vehicle automatically demands good roads and the use of motor vehicles increases in proportion to the improvement in the mileage of good roads, the all important point is that the mass citizenship is bettered by the improvement of roads, as it is an old adage that civilization and development follow improvement of transportation facilities.

Even the interests of the steam and electric roads may ultimately be served better by low taxation of motor vehicles than by high taxation. The steel rail carriers, both steam and electric, are the transportation industry. Sooner or later they will own and operate their own motor truck and motor bus lines, probably using trucks very extensively in store door delivery which is beginning to be demanded by merchants and wholesalers; and motor busses for the economic handling of their short haul and local passenger business and to supplement and probably, in many congested districts, to support or supplant already established lines.

In fact, as there are now dozens of electric railway and steam railway companies who own and operate both motor trucks and busses, they are just as much interested and will be more interested in the future in keeping down the taxation on motor vehicles as will the makers of motor equipment.

Boomerang Taxation

For this reason, it seems fitting that all transportation interests—the electric railway and steam interests as well as the motor interests—can well refrain from agitating for taxation which may ultimately tend to become a boomerang tax, and thus, prove burdensome to their own operations. Especially is highway tax agitation futile when it merely tends to widen the transportation cost breach existing between consumer and producer and as well to reduce the volume of goods which may be transported by motor for short haul and thus increases the unprofitable short haul tonnage to be handled by the railways.

Webster was Saying It Back in 1843

The improper use of highways by overloading motor vehicles should be denounced and effective legislation enacted to curb this practice; but the statement made by Daniel Webster at the Rochester, N. Y., Agricultural Fair on Sept. 24, 1843, is just as true today as then—"That one great duty of the Government is to see that the products of our rich soil and industrious labor may be easily, speedily and economically transported to the place of consumption and sale." Certainly the motorizing of our highways is a big step in furthering that end and government might properly subsidize the increased use of the motor vehicle rather than penalize its use.

The use of the motor truck by the electric railway service departments has naturally been proven economical as a factor in trolley operation much quicker than the use of the motor bus by the passenger departments.

In this service for public utility corporations, there are as many different kinds of uses for the motor truck as there are different types of work to be done. They are so varied it would be impossible to name them all.

Motor Truck Uses in Electric Railway Service

A few statements of their service to the electric railway industry will suffice to suggest the possibilities: First, in importance, is undoubtedly speed in repair work. The public will forgive almost anything except delays. When a break in a regular service occurs almost anywhere in the country the first call is for a motor truck repair outfit. Day and night they are kept on guard.

Emergency tower trucks speed at 25 to 50 miles per hour to repair line breaks. At one of the Georgia Railway and Power Company's substations, for instance, a motor truck was used to move a 20 ton converter into position in the substation.

Where cable is to be strung on lines or go into conduit, the truck equipped with power is indispensable both for use in loading and unloading the reel at the warehouses and for paying out the cable or drawing it through conduit in the field.

Poles are carried into the field. Frequently the power of the truck or the winch is used in setting them up greatly conserving the number of men required for this work as compared with the old method. Cross arms, insulators,

transformers, tools and men all accompany the construction—often enabling one crew and one truck to perform work formerly requiring a number of teams and two or more crews.

Where excavation is required they are always on the job with tools, materials and men—dependable in all weather, durable through merciless punishment and most economical as well.

Where series of wires are to be strung on pole lines, some companies have rigged the trucks with special racks, feeding from eight to ten wires at a time, carrying all cross arms and insulators required at the same time. Many times trucks have been used by power companies to move buildings on their property.

Electric railway companies, in a number of cases, have had cranes mounted on motor trucks to assist in construction and repair work and to give speedy aid in removing obstructions if a line is blocked.

Motor trucks are used for patrol work; to haul fuel; to transport men and material on every kind of work, and anyone familiar with the field needs of electric trolley can specify dozens of other uses.

In addition to the tremendous value which the motor truck represents in the service departments of the electric railway field, there is a use for trucks for supplementary freight service which may soon grow into large proportions, for the extension of electric railway freight lines into off line territory, as has been inaugurated by the Cincinnati, Aurora and Lawrenceburg Electric Railway Company. Finding themselves blocked for freight delivery and receipt at a point located five or six miles from the business center of Cincinnati, they have adopted the use of the demountable body or uniform container in use by the steam railroads of Cincinnati. They have established a service which enables them to meet steam railway competition and to give store door delivery. Arrangements were made with the Cincinnati Motor Terminals Company to supply them with their specially designed container truck bodies and to supplement service from their outside terminal to the heart of the business center, by using these truck bodies on flat cars instead of using box cars for freight. By this system, the truck bodies are immediately removed from the flat cars of the electric railway company just as soon as they arrive at their terminal. The Motor Terminals Company immediately takes them on its trucks, of which a large fleet is maintained in Cincinnati for steam railroad service. This enables the electric railway to make delivery to the off track downtown terminal within a few minutes after the arrival of the flat cars at the outside electric terminal. Or, when the consignment is in quantity it may be delivered direct to store door or warehouse of consignee in record time and without rehandling.

By this same method, the container bodies are filled for out-bound service at the off track terminal in the heart of the city and transferred by motor truck to the electric terminal. Delivery to local way stations is then made direct from the container bodies carried on their flat cars.

This system not only saves much loss from damage, theft and misplacement, but it relieves the trolley company from much extra checking, rehandling, etc., and enables the trolley line to provide a service excelling that of any other transport. This system also is less expensive than direct motor truck haul in this case. A somewhat similar operation, using trailers, is in service in Chicago, as part of the freight system of the Milwaukee Electric Railway Company.

What the Motor Industry Pays the Government

As the question of contribution made to the public purse is a very important feature in any consideration of the subject of motorizing our highways, it is interesting to check up some of the dollars and cents facts. They are all very startling facts.

For instance, what man in the electric railway field, not definitely interested in the motor industry, is aware that the Internal Revenue Department of the United States received from the motor industry in the year 1921, the amazing sum of $115,546,299.31 as excise tax alone, and, in addition, the sum of $1,776,493.88 as excise tax on passenger vehicles for hire?

These millions are all in addition to the normal income tax and excess profit taxes paid by the manufacturers out of their profits as manufacturers.

In comparison, this excise tax alone, represents a sum almost one-half as much as the government received in returns from the tax on the transportation of all freight, all express and all passengers by all the steam railroad and electric lines in the country.

This motor industry contribution represents almost five times the government

collections in taxes on telephone, telegraph and radio messages.

Corporation returns distributed by industries are not yet available for the past year, 1921; but if the motor vehicle manufacturing returns merely equalled those of 1919, (and with almost 2,000,000 more vehicles registered last year than in 1919, it is reasonable to presume they exceeded 1919) then the motor industry contributed in income tax and excess profits tax, including motor vehicles and automobile bodies, but not including the returns from the tire and accessories industries, a total of $79,675,544.

This 1919 tax paid, was four times the total tax paid by all of the manufacturers of electric machinery, stationery and marine engines, refrigerating machinery, etc., combined.

These are governmental facts shown under Table 9 of Internal Revenue Department statistics issued in 1922 covering returns of 1919, and under Table 3, page 89, of the annual report of the Commissioner of Internal Revenue for 1921.

But that is not all which should be brought to your attention as this motor truck and motor bus industry relate to the financial side of our government revenues.

Motor License Fees in 1921

From the Department of Agriculture, Bureau of Public Roads, I have a tabulated sheet brought up to date and covering the year 1921, which shows that the various state governments, either as state revenues or as highway department revenues, received the grand total of $122,478,654.34 as gross motor vehicle and license revenues for the year 1921.

This tremendous sum, if applied solely to maintenance of highways (not new construction) would pay for all the maintenance necessary to keep our highways in perfect condition after they were initially paved with proper pavement to serve reasonable traffic, as it is estimated that 10 per cent per year of original cost will maintain any properly designed and properly constructed pavement for any class of traffic. This vast sum of over 122 millions would thus maintain an expenditure of over $1,225,000,000 for new pavement. No such sum has been expended for pavements, even if all the expenditures of all our states were combined with the contributions of the United States government for highway work.

Taken as a total sum contributed as income tax, excise tax, or as license revenue; the automobile, motor truck and motor bus provided a grand total of over $317,700,447 of revenue to the state and national governments in 1921.

It is a fact that this was indirectly contributed by every user and owner as well as by the manufacturer but the great total is an emphatic argument to direct universal attention to the extraordinary progress this country has made in a decade in local transportation. For, with few exceptions, all motor vehicle use, whether pleasure car, motor truck or motor bus, is local.

The total registration of motor vehicles for 1921, as shown by the tabulations of the Bureau of Public Roads, was 10,465,995. Of these, 9,342,844 were passenger cars; 982,604 were trucks and commercial cars; 50,547 were taxis and busses.

Facts for the Consideration of Electric Traction Interests

These figures are startling. They are very important in interesting the electric railway industry when compared with the statement from the January 7th issue of the Electric Railway Journal to the effect that there were 149.79 less miles of electric rail in service in 1921 than in 1920 and that the total of cars and locomotives in service was only 106,385 in 1921 as compared with 106,688 in 1920.

These figures are still more interesting when surveyed in the light of the increase in our population and in the general tendency to greater movement which came as the result of travel and change for so much of our population during the war.

These figures should be beneficial to the electric railway operators. Information often stimulates activity. Activity rightly directed usually increases profits, improves service, and broadens operations.

In the present situation as it relates to the use of the motor truck for carrying freight, in co-operation with the electric or steam railway and as it relates to the use of the motor bus or the rail bus for carrying passengers in co-operation with either, this new means of local transport offers an opportunity. It is an opportunity for the railway interests to be carried along into this new field of transportation.

Sound, careful, intelligent investigation will easily disclose to the interested railway operator that these almost 11,000,000 vehicles cannot now be superseded by systems of either steam or electric transportation.

More careful analysis will also un-

doubtedly show that in a majority of cases not only the passenger cars, but the motor trucks and motor busses as well have been used to take care of business and personal demands for a class of transportation which either could not be cared for by the steam or electric units or for a class of transportation which it would be actually unprofitable for the older system to handle at the rate which is profitable to the motor vehicle.

The motor truck for short haul freight service offers the opportunity to pick up freight and make delivery with just two manual handlings of the goods as compared with four handlings if the goods must be loaded into and taken from a box car.

In passenger transportation the motor bus offers a system supremely flexible which may be co-ordinated profitably with a system rigidly inflexible.

Ultimate "economy" is a Juggernaut. That which will give to the greatest number the most good for the least money is the system of transportation which the transportation fraternity must provide.

You are the transportation fraternity. The problem, if there is one disclosed, is entirely one of profit. Each unit used by the fraternity must produce a profit. Without profit to inspire there is no interest. Without interest, there will be no energy expended to provide service, for energy is born of interest.

Already many of the electric railway fraternity have been inspired by the profit in motor truck and motor bus operation. They have expended the energy necessary to investigate. The more carefully more investigate, the more rapidly will this new transport unit—the motor vehicle—be inducted into service as an integral part of electric railway operation.

TRAFFIC CAPACITY AND WIDTHS OF COUNTY HIGHWAYS

By H. C. Smith, State Highway Laboratory, University of Michigan, Ann Arbor, Mich

(Editor's Note: Following is the report of the committee, of which Mr. Smith is chairman, of the National Highway Traffic Association, as submitted at the Conference of the Association held in New York City on May 12.)

There has been a large quantity of statistical data compiled throughout the country in the nature of traffic censi and many traffic studies have been made to determine the future traffic for given highways. Most of such data is not of maximum value, however, in determining the desirable width of roadways for a given traffic, inasmuch as the variation in speeds of various classes of vehicles generally is not given consideration. Any computation of required width of roadway, based upon the assumption that all the traffic on a given highway outside of a municipality will travel at a common speed, should be used with great reserve as the assumption is obviously incorrect in all but exceptional cases.

For the greater part, highways outside of municipalities need have but two lanes of traffic to care for the traffic which they are called upon to accommodate. Highways leading into large municipalities or connecting nearby cities, however, present a problem that calls for careful solution inasmuch as they may and often do carry traffic that varies in speed from about 3 miles per hour to 35 miles per hour. In many cases the quantity of traffic approaches and often exceeds the economical traffic capacity of a two-lane roadway, although computations may show that the amount of traffic anticipated from traffic surveys could be carried adequately by a two-lane roadway if the traffic assumed to travel at a common uniform and properly selected speed.

Factors Governing Width.

In cases of highways which are to carry congested traffic, the designing engineer must give careful consideration to all functions of a roadway which should affect his decision in choosing the number of lanes of traffic to be required and the modification of widths of roadways and shoulders for any given number of lanes. The function of a roadway which thus affect the design of its width are enumerated as follows:

1. To provide a sufficient number of lanes to carry the traffic that comes upon it.
2. To provide means of allowing fast moving vehicles to pass vehicles moving more slowly, the speeds being within legal and operating limits.
3. To provide for the ranking of vehicles at the roadside in such cases as for necessary temporary repairs.
4. To be of such width as to discourage the taking of dangerous chances by operators of vehicles.

When a two-lane roadway has become so congested that it is impossible to operate a vehicle without considerable loss of time due to traffic delay, its economic traffic capacity has been exceeded. This degree of congestion occurs for a traffic count of a great deal less than that equal

to the computed traffic capacity of the roadway when variation in speed is not considered. As the amount of traffic or speed variations increase, the possibility of passing a slowly moving vehicle when it is overtaken becomes less. Ultimately, it becomes entirely impossible for vehicles to pass each other and all traffic must assume the speed of the slowest moving vehicle.

Results of Investigations

To emphasize the relation that should exist between traffic and roadway widths, the results of office computations and field observations of traffic operation made by the chairman of the committee may be of interest.

For one typical series of investigations for a two-lane roadway, a traffic of 750 vehicles per hour was assumed, 500 of which traveled in one direction, the remainder traveling in opposite direction. Three assumptions as to variation in speeds were made.

First—Three per cent were assumed to travel at 3 miles per hour, 10 per cent at 10 miles per hour, 57 per cent at 20 miles per hour and 30 per cent at 30 miles per hour.

Second—Thirteen per cent were assumed to travel at 10 miles per hour, 57 per cent at 20 miles per hour and 30 per cent at 30 miles per hour.

Third—Thirteen per cent were assumed to travel at 10 miles per hour and 87 per cent at 20 miles per hour.

Effect of Slow Moving Vehicles.

It was found under the first assumption that the meeting of two of the 3-mile-per-hour vehicles slowed down traffic each way along the road for a distance of one-quarter mile. The meeting of vehicles of various faster speeds affected the movement of traffic similarly but to a less degree. It was also evident that 750 vehicles per hour, two-thirds of which is traveling in one direction and under the first outlined assumption as to variation in speeds, could not be operated on a two-line roadway.

Under the second assumption of speeds, the meeting of two slow vehicles affected the traffic for a distance each way along the road of 300 ft., and the operation of traffic under this assumption was entirely possible.

Under the third assumption the traffic was shown to operate smoothly and the quantity could have been considerably increased.

The results of these computations were checked by observing the operation of traffic on roadways leading into Detroit, and the observed effect of varying speeds checked the calculations quite closely.

The foregoing results should be compared with computations based upon the assumption that all vehicles will travel at a common speed. Under logical assumptions as to clearance between vehicles, and assuming that all vehicles will travel 15 miles per hour, a two-lane roadway should carry about 2,600 vehicles per hour in each direction. If the speed is reduced to 3 miles per hour by a few heavy horse-drawn vehicles, the capacity is reduced to about 750 vehicles per hour in each direction. There can be no doubt, therefore, that the variation in speeds affects the traffic capacity and hence the required width of a roadway.

Quite obviously, a stalled car which, through inadequacy of shoulder design, is prevented from pulling to one side and hence blocks one lane of traffic, has the same or a worse effect on the traffic capacity of a roadway than a slowly moving vehicle. The roadway traffic capacity can be materially increased by adequate width and design of shoulders.

The safety of traffic should not be disregarded in the design of roadway widths. In the case of a two or four-lane roadway, every vehicle operator realizes just when he has the right-of-way and when he has not. The operation of a three-lane roadway, however, is not so simple. The center lane is not and cannot be reserved for traffic in either direction, so it must be left to each individual operator to decide whether he is more entitled to this lane than another operator going in the opposite direction. Such a width of design fosters danger to traffic.

Conclusions.

Your committee respectively submits the following tentative conclusions for consideration:

1. The design of roadway widths must give consideration to the economically desirable variation in speeds of the various classes of traffic.

2. Any two-lane roadway carrying intensive traffic should have a width of 20 ft. and should have 5 ft. shoulders capable of sustaining standing vehicles for temporary delays.

3. A two-lane roadway should be increased to a four-lane roadway when the traffic is reduced to the speed of the slower vehicles through not being able to pass, if the economic loss of time will justify the expense.

4. The building of three-lane roadways should be discouraged due to the danger to the traveling public.

PAVEMENT WIDTHS FOR HIGHWAYS SERVING LARGE CITIES

By William F. Cavanaugh, Milwaukee County Highway Commissioner, Milwaukee, Wis.

According to the census of 1920, we have in the United States today 12 cities with a population in excess of 500,000 people and 56 cities with a population between 100,000 and 500,000.

A large percentage of the more heavily populated cities today have hard surfaced highways radiating outward from their corporate limits that are entirely inadequate to handle traffic because of their narrowness, said Mr. Cavanaugh in addressing the American Road Builders' Association.

This is not due to a lack of foresight in most cases on the part of highway engineers but due mainly to the fact that these communities are not in a position to finance the building of a highway of a greater width.

Considerations Governing Width

In choosing the proper width to construct a new highway or to widen an old one it is sometimes quite difficult to determine what width is proper. We have to consider first of all the amount of traffic it takes before construction together with the expected increase it will afterwards be called upon to take. It may be that in succeeding years adjacent and parallel highways will be built and a certain portion of traffic will be diverted over them.

In starting construction at the limits of a city that part of the highway through the outlying districts often requires a greater width than further on due to a greater traffic on account of conditions being similar to city conditions and being more heavily populated than portions of the highway further on.

In these communities it is well to take the future growth or expansion of the city into account and plan accordingly adopting the proper alignment and grades so as afterwards to conform to the grades and alignment of future intersecting streets. Drainage structures should also be planned with this end in view.

In the event that a highway is to be paved 20 ft. wide with the intention of later increasing this width it is well to construct the 20-ft. width to conform to the center line of the right-of-way and not make the mistake that some communities have in building along the old roadbed which deflected here and there from the center line. The main idea of course in so doing was to cut down on the grading cost and obtain a more solid foundation. Afterwards when these territories build up and the traffic increases it becomes necessary to widen the roadbed and it cannot be uniformly widened on each side and the result is the proper crown cannot be obtained on the new road and there is not a uniform sidewalk space. Additional right-of-way has to be purchased.

Highway Lighting

An 18 or 20 ft. highway is especially hazardous for pedestrians at night time where highways close to a city are not illuminated. Most states have regulations regarding automobile headlights but the lack of illumination has been the cause of a great many accidents where autoists have run into and injured or killed pedestrians. We have some of our highway in Milwaukee County illuminated and expect to continue this work each year. We are using ornamental concrete poles with the bracket light and the cables laid underground. Unless these lights are elevated to a height of at least 25 ft. there is a very noticeable glare on the eyes of the passing motorist.

Sixteen-ft. Roads Inadequate

Most of our 16-ft. roads today are inadequate especially so when there is any amount of truck traffic and the major portion of our highways are being constructed 18 or 20 ft. wide. This width suffices to care for two lines of traffic. Some consideration should be given to the matter of constructing a 30-ft. width which does not provide for more than three lines of traffic. We often speed up to pass the car in front and doing so may frequently meet another driver doing the same thing coming towards us and the result is a head-on collision in the center. It almost seems that in providing increased widths we should provide for either two, four or six lines of traffic.

The Use of a Curb

I believe the use of a curb is warranted on wider roadways as the fills do not have to be constructed as wide and the shoulder width can be cut down especially through the cuts, doing away with ditching; the drainage structures do not have to be built as wide and less right-of-way is necessary. It is clearly not good engineering to provide either inadequate or extravagant widths and it is often the case that a pavement 3 or 4 ft. narrower than the one laid would serve all the purposes of the wider one or an additional

3 or 4 ft. to a pavement along a highway especially with a car line will provide for two extra lines of traffic. Pavements are expensive to lay and should therefore be only sufficient to provide for traffic needs during the life of the surfacing.

The blind acceptance of right-of-way widths irrespective of the various uses to which streets are being put is especially unwarranted in the outlying parts of the city where houses are just beginning to be built and where the widening of main lines of travel would be comparatively cheap.

Experience the world over teaches us that old highways must be widened when the opportunity arises but a community without a definite plan or program lets these opportunities for widening pass by.

BRICK CONTRACT AWARDED ON AN ILLINOIS STATE HIGHWAY

Contract for construction of the first brick road to be built by the state of Illinois since Governor Len Small's "$30,000 a mile" edict went into effect, has just been let by the Illinois State Highway Department. While smaller political units in the state have been building brick roads right along, this is the first action of its kind on the part of the state highway department, under the present administration.

This follows closely a similar action on the part of the Indiana State Highway Department. Indiana, however, was one of the last states in the union to establish a highway department, and while many miles of brick roads have been built by the various counties in Indiana the recent contract by the state was the first since formation of its highway department.

Thus two states which rank high in proposed mileage of modern, improved highways have put their official stamp of approval on vitrified brick for highway surfacing after a more or less extended period of concentration on other types.

The Illinois contract, let to J. E. Craine of Murphysboro, Ill., is for 13.32 miles on Route 2, sections 12 and 13, extending from Cobden to Dongola, Ill. Specifications provide for a base of 10 ins. of Novaculite, laid in two 5-in. courses, a 1½-in. sand cushion, 3-in. vitrified brick and asphalt filler. Curbs of compacted Novaculite will be 12 ins. wide and 4½ ins. deep. The pavement will be 18 ft. wide.

"Novaculite" is a trade name of a local material found in Southern Illinois which is a silica product, or what some engineers call disintegrated chert. It contains alumina and oxide of iron, commonly called "clay binder" and when rolled and compacted sets up hard with cementing characteristics. Like crushed stone, slag, or gravel where available, it is looked upon as a good base material when a rolled base is desired.

The Cobden-Dongola road is a portion of one of the principal north and south highways of the state which, starting at Decatur, runs due south through Pana, Vandalia, Centralia, and Carbondale to Cairo, on the Mississippi river. When completed it will be one of the heavy traffic routes of the state.

In Indiana the recent brick contract was for a 6.89 mile section of the heavily traveled and widely known National Road. There too, 3-in. brick and asphalt filler were specified.

NORTH CAROLINA HAS SCHOOL FOR HIGHWAY INSPECTORS

North Carolina, in carrying out its $50,000,000 highway program, has introduced a departure that promises to set a swift pace for other states to follow. As a means of qualifying its inspectors for the inspection of bituminous paving the North Carolina State Highway Commission, through its Division of Tests and Investigations, has established a short course in bituminous laboratory and plant instruction. The course is necessarily a short one and consists of taking the men into the laboratory for about a week to learn the different tests of the materials used and to attend lectures by the supervisors of this type of construction. After the laboratory and lecture courses are over, the men are taken to the asphalt plant for instruction in the duties of the plant inspector and then on the road for instruction regarding the construction methods to be used.

The men for this work were secured mostly from the different districts into which the work of the State Highway Commission is divided. The number of men from each district is proportional to the amount of this class of construction to be carried on. This will allow the men to be located in the same district they came from, and the only need for any change would be in the demand for emergency inspection from another part of the State.

EDITORIALS

EYES AND THE PEDESTRIAN

A prime cause of automobile accidents lies in the fact that many pedestrians have not yet learned to think in terms of motor traffic. In other words the "wheels in the head," about which we heard much some thirty years ago, have not yet been equipped with rubber tires. More specifically, too many people forget to use their eyes and depend entirely for their safety on their sense of hearing.

In the old days when traffic was horse-drawn and iron-tired it was noisy and moved slowly. The pedestrian, even though asleep on his feet, was awakened by the grinding of the iron on the roadway or by the clatter of the horses' hoofs, and had plenty of time to get out of the way. Now traffic moves swiftly and quietly; it steals up on one with what Arnold Bennett might call "the imperceptible stealthiness of a bad habit." The sense of hearing is not sufficient to protect one in crossing a street, for the noise made by an approaching motor vehicle is often indistinguishable from the hum of the city. The safe plan is to look both ways before stepping into the line of traffic and then give the right of way to everything on wheels. Railway track men, and others who have occasion to walk on railway tracks, learned this lesson long ago.

IN DEFENSE OF THE TALKATIVE FEW

In an editorial on: Why Engineers Stay Home, a contemporary journal recently made out a strong case against the "time-wasters" who do so much talking at engineering society meetings. It is quite possible to agree that a few do all the talking, not only in engineering meetings, but in the general run of meetings of business and professional men of all classes, even in the United States Senate, and still reach more than one conclusion about the best remedy for this unfortunate situation. If the talkative few should suddenly become quiet, assuming that this is possible, it does not by any means follow that those who had been content with thinking parts would as suddenly become vocal. In fact, we have observed on a number of occasions when those who usually "do all the talking" were absent, or silent, that those who usually remained silent kept right on remaining silent. For example, water works superintendents often complain that the consulting water works engineers do all the talking at the water works conventions. Some years ago this feeling threatened to disrupt the American Water Works Association. When it came to the attention of the engineers who had been doing so much talking they suddenly became comparatively quiet. Did the superintendents seize the opportunity to start talking? They did not. They remained silent and the chairman of the meeting was forced to call on individuals for expression of their opinions in order to keep the proceedings from dying out entirely.

While those who talk undoubtedly appreciate the value to themselves of being active in this particular, it is also true that, in the great majority of cases, they want by this means to promote the "good of the order," to assist in the advancement of knowledge, to encourage others to talk, to make the meetings interesting, etc. On the other hand it should be recognized that those who remain silent do so from choice and not from necessity. We do not recall a single case, in many years' attendance at engineering society meetings, where the chairman refused to recognize any member who wanted to address the meeting. The chairman's greatest problem is to get somebody to say something, rather than to squelch the few who are able and willing to talk. So, while we admit that discussion is often prolix and even entirely off the subject before the meeting, the remedy lies in encouraging more people to talk rather than in persuading the willing talkers to "make it short." A few do all the talking only because the many will not talk.

INDEX TO VOLUME LXII

The index to Vol. LXII of Municipal and County Engineering, January to June, 1922, is now ready for distribution and

copies will be sent free on request to subscribers. All subscribers are urged to bind their copies since this can be done at trivial cost, and the bound volumes of this magazine are very valuable for reference purposes. Every issue contains much matter of permanent worth which should be preserved.

WALKING ON THE HIGHWAY

It is a common experience when driving on highways near large cities, especially on Sundays, to see hundreds of people walking on the paved roadway and every last one of them on the wrong side of the road. That is, with almost negligible exceptions, those who walk on the roadway walk with the traffic instead of against it. This frequently leads to accidents for which the motorist gets all the blame. The wonder is not that some are injured in this way, but that the number is so small. Very often pedestrians may be seen walking three or four abreast, forming a line that completely obstructs one traffic lane. They have their backs to the traffic on their side of the pavement and pay no attention whatever to signals to move over.

Whatever may be said of the rights of the pedestrians and of the motorists in such cases, one must marvel at the assurance of the pedestrian that the motorist not only must not, but will not run over him. Many pedestrians do move over, perhaps the majority do, and this leads the motorist to expect the pedestrian to give ground; therefore when an occasional pedestrian does not give ground he runs a grand chance of getting hurt or killed.

In walking on the highway a pedestrian should face traffic and keep to the edge of the roadway, quite as much to insure his safety as to conform to the old rule of the road. Pedestrians have always yielded ground to wheel traffic and this is the sensible as well as the proper thing to do.

MUNICIPAL BOND SALES

Municipal financing reached what will probably prove to be the peak for 1922 in the month of June when an aggregate par value of $154,273,633 permanent state and municipal bonds were successfully marketed. This brings the total for the year up to $713,070,097. Should the balance of the year see as much additional borrowing on the part of the states and their political subdivisions, the record total of 1921 will be exceeded.

ADVERTISING SIGNS ON THE HIGHWAYS

Although we have favored the regulation, or censorship, of highway advertising signs, rather than their absolute prohibition, the weight of opinion is clearly in favor of driving these signs off the highways entirely. Perhaps there will eventually be a reaction against this form of prohibition and the signs may be allowed to come back under proper regulation.

While we have no selfish interest in billboard advertising we dislike to see the boards lose out entirely. The newspapers started the fight and apparently have it won. Money that went into billboard advertising did not go into newspaper advertising and that caused the newspapers to wage their war of extermination on the boards. If the public interest in this matter really requires the removal of advertising signs there is nothing more to be said, but we cannot agree that this is the case. The advertising sign may be made an aid to the traveller, rather than a source of danger to him or a blemish on the face of nature; this result could be secured by regulations imposed by highway authorities.

In town, too, the billboards are losing out, and this despite their demonstrated worth. Who does not recall the use the Rotary Clubs made, not long ago, of billboard advertising in their campaign to improve business conditions? Many people read the boards who seldom read newspapers or magazines. Then, too, when one is on the move and catches the flash of a few words on a sign, he has time to think of their import before his mind receives another impression. Suppose some ethical culture society should start out, little by little, to improve the human breed. Could they find an adequate substitute for the billboard? It may be doubted. Suppose it was desired to direct attention to Prejudice, the force that arrests the political and social regeneration of the race. A billboard campaign directed against prejudice would do more to lift this blight from human life in 60 days, than all the books ever written have been able to do down to this hour.

So we rather dislike to see the boards go for, rightly used, they would throw flashes of light across "the dark night of man's mind."

EFFECT OF CORE DRILLING ON PAVEMENT PRICES

The editorial entitled: Effect of Core Drilling on Pavement Prices, published on pages 159 and 160 of the May, 1922, issue, has lead to considerable discussion of this timely topic. Discussion in this case as always is highly desirable as it is through discussion that knowledge advances and justice is established and maintained. The editorial has been well received by some readers but other readers are unable to agree with the thoughts it expressed. Inasmuch as this is a journal of honestly-held opinions no objection exists to the publication of views partially or entirely at variance with those held by the editor.

Although the editorial stated that core drills are being used by several state highway departments, and the discussion was intended for national rather than state application, the specific example cited pertained to Indiana practice and this fact not unnaturally led some to conclude that the Indiana State Highway Department had been singled out for criticism but this, of course, was not the intent of the editorial. This impression, however, has led to some very interesting and valuable comment in Indiana, typical examples of which are here reproduced for the information of our readers.

Mr. C. Gray, Chief Engineer of the Indiana State Highway Commission, gave out the following statement with reference to the editorial:

"An editorial in the May number of Municipal and County Engineering, entitled, 'Effect of Core Drilling on Pavement Prices,' takes exception to use of the core drilling machine for checking depth of pavement. The article attempts to show that it is unfair to contractors and will increase the cost of our pavements.

"The Indiana State Highway Commission is anxious to secure construction of highways at the lowest possible cost of each individual type, but not to the extent that we would have an understanding with contractors that a shortage of depth in the pavement would be permitted.

"The article states, that where a core drill is to be used, the specifications should make the fact clear. Our specifications do make such provisions, but I fail to see where such a clause is absolutely necessary, as our cross section shows the design of the pavements in detail, including the depth, and our form of contracts provides for the construction according to the plans and specifications. The writing of adequate specifications and the proper design of pavements means nothing unless the plans and specifications are carried out during construction. The article also states that if a thin slab means that the engineers and inspectors on the job are to be discharged, the contractors are in for a hot summer. This is exactly what it means on Indiana work—in addition to the fact that the contractor will not receive payment for deficient pavements.

"We require from 75 to 100 engineers and inspectors on our construction work during the construction season, and in order to secure technically trained men with practical experience, it is necessary to hire men from all parts of the country, about whose honesty we know nothing more than that given by their references. One can readily see that there is a possibility of securing those who would be susceptible to offers of compensation from contractors. There is also the possibility of contractors intimidating the inspector. We have a clause in our specifications which states that on completion of the work, the chief engineer shall make a final inspection of the work before final payment is made. The coring of the pavement is a part of this final inspection and is a protection to the State against dishonest contractors and inspectors.

"The core machine protects the taxpayer, the honest inspector and the honest contractor. With a definite check on the work, the honest contractor does not have to compete with contractors who bid low with the expectation of 'getting by.'

"Mention is made of the fact that if the engineer is liberal in his interpretation of the specifications, the contractor will not be greatly worried by the core test. Taxpayers have invested thousands of dollars in 'liberal interpretations of specifications' in past years, and it is due time that they insisted that all of the money be placed in mileage of roads.

"I am of the opinion, that the Department, with the opportunity of observing the construction of hundreds of miles of roads under different conditions, and where many different methods of construction are used, is in as good a position to judge as to what degree of accuracy it is possible and practical to work, as is the average contractor."

Honesty in Road Building

The *Evansville* (Ind.) *Journal* for June

30, 1922, ran an editorial entitled: Honesty in Road Building, which quoted the major portion of Mr. Gray's statement and added the following original paragraphs:

"When representative periodicals devoted to public improvement, and reflecting in part the opinion and sentiment of contractors, protest against absolute quality tests by the Indiana Highway Commission on road surfacing and foundations, it's curiously interesting to the taxpayer. The theory of one such protest, appearing in Municipal and County Engineering, published at Indianapolis, is that core drilling to test road foundations is both unfair to the contractor and will increase the cost of paving. To such a contention C. Gray, Chief Engineer of the Highway Commission, presents a sufficient and convincing answer.

"Mr. Gray says, with a touch of irony, that 'taxpayers have invested thousands of dollars in past years in liberal interpretations of specifications.' Anything that will insure a dollar's worth of material and labor for a dollar's worth of pay on road work will be received with profound and solemn satisfaction by the people. Any road that isn't built according to specifications contains less than the people are paying for.

"Every road contractor is entitled to his fair profit on every foot of work that he does. But the State of Indiana, far from being criticized, is to be commended for devising a method that will reveal whether roads are up to standard. Any insinuation from a supposedly authoritative spokesman of the contractors that the continuation of core drilling will mean higher prices in future comes in shockingly poor grace. It is tantamount to an admission that some contractors have been scamping their work. And it's precisely that condition that the core drill is meant to reveal and prevent."

The Indianapolis News, for July 1, 1922, ran an editorial entitled: The Road Core Question, as follows:

"The plunging of a corer into what has every appearance of being a perfectly good watermelon, often seems like a ruthless and damaging proceeding, and yet it adds greatly to the confidence of the purchaser that he is getting his money's worth. The same line of thought applies to the question of the use of a coring machine by the State Highway Department on roadways to determine whether they have been constructed according to specifications. A trade magazine devoted to construction work seems to have been shocked at the thought of the cruel corer's plunge into a pretty pavement, and to have discussed this in an editorial on 'The Effect of Core Drilling on Pavement Prices.' No doubt a strong case could be made showing that coring of watermelons tends to raise the price, but the wise buyer would rather pay the higher price than run the risk of taking the untested melon.

"The general public, therefore, which is the real purchaser of pavements, will be likely to take comfort in the attitude of C. Gray, Chief Engineer of Construction of the State Highway Department, who appears to believe that a pavement should show itself to be really ripe before it is paid for. In reply to the trade publication comments he says:

> The writing of adequate specifications and the proper design of pavements, means nothing unless the plans and specifications are carried out during construction. The editorial says that contractors are in for a hot summer if concrete pavement not exactly up to specifications means that engineers and inspectors on the job are to be discharged. This is exactly what the Indiana Highway Department means to do, and in addition, the contractor will not receive payment for deficient pavements.

"The use of the coring machine is to check up on previous work of the department's inspectors. Mr. Gray calls attention to the fact that from 70 to 100 engineers and inspectors are required on construction work in the busy season. In order to obtain technically trained men with practical experience it is necessary to engage men from all parts of the country, about whose honesty the department may know nothing more than is given in their references. Some may be susceptible to offers from contractors, and some may be of the kind that can be intimidated by contractors. Says Mr. Gray:

> The core machine protects the taxpayer, the honest inspector, and the honest contractor. With a definite check on the work, the honest contractor does not have to compete with contractors who bid low on projects with the expectation of getting by with dishonest work.

"This sounds like good sense. The spirit of Mr. Gray's remarks is of a kind that tends to be heartening to those who hope for roads good all the way down. For the solid satisfaction of such roads

taxpayers should be as ready to pay as the melon consumer is willing to give something more for fruit good right up to the rind than for melons of uncertain quality."

Our editorial on the subject is on record and easily obtainable by any interested person so there is no occasion for reproducing it here. Our discussion turned on the point that the core test "may be fine in theory but not so good in practice." We also stated, and still maintain, that: "The engineer who intends to use the core test before paying for a pavement should make that fact very clear in his specifications. The contractor should be warned in advance of this new hazard in his already very difficult and hazardous calling. The method of making the tests should be made known to the contractor before he starts to build and he should also be told just what interpretation will be placed on the test data and how these interpretations will affect the payments due him." In other words, if a depth of 6 ins. is specified is that to be regarded as the minimum depth, or as the average depth with a variation of ½ or ¼ in. below the specified depth permitted? Again, if a penalty is to be imposed for a deficiency in thickness what about a bonus for an excess? We believe that since a pavement cannot be constructed, under field conditions, with the same precision as a test specimen in the laboratory, that it is no more than fair to tell the contractor just what variation from standard will be permitted. We do not believe that fairness to the public, in whose service we have produced this magazine for 32 years, requires that the contractor who bids on a 6 in. pavement should be scared into building a 7 in. pavement. Perhaps that contingency will not arise; we hope not, for eventually inequities react against the public. The use of the core test is not necessarily unfair but it may be unfair—we argue merely for fairness in its use realizing from construction experience the great difficulty of an absolutely exact compliance with any set of specifications, no matter how pure the motives of the contractor may be.

With reference to the effect of the test on pavement prices we note with lively sympathy what *The Indianapolis News* says about "plugging" watermelons. Never was comparison more apt. We are also of the opinion that it is better policy to pay more for a plugged melon of demonstrated quality than to take a chance on acquiring unripe fruit. If the public is willing to pay more for a "cored" pavement than for an "uncored" one, as the *News* advises, we have no objection but would be the first to applaud such a sensible policy. What we would oppose, in the name of the entire construction industry, is furnishing any "cored" commodity to the public, whether melon or pavement, at "uncored" prices. And right there we rest our case.

ECONOMIC ASPECTS OF TOURIST CAMPS

To the Editor:

While your editorial on "Tourist Camps," which appeared in the June issue, contains no misstatements, it tends to leave with the reader several impressions which, viewed in the light of an extended investigation of this subject which I have been carrying on for several months, seem to me to be erroneous.

The viewpoints of the hotel man and the taxpayer are certainly entitled to consideration—but just what are these viewpoints?

In the development of tourist camps it has not been unusual to encounter apprehension on the part of hotel-keepers as to a possible loss of trade due to the existence locally of well-developed tourist camps, but in certain specific instances, at least, this feeling has disappeared after the local camps have been in operation for a short time.

The general tendency of tourist camps is to encounter tourist travel by automobile. The hotel man profits by this increased tourist travel, as a portion of the increase results in at least occasional hotel patronage.

In the case of small towns, it is seldom that the local hotels are of a character that cause the town to be seriously considered by tourists as an overnight stopping place. It is usually easy to push on to a larger place offering better hotel accommodations. Any town, however, can afford to establish an attractive camp and maintain it properly, with the result that many tourists will stop for the night rather than drive on to the next camp.

While in most tourist camps there may be found touring parties that could readily afford to patronize the best hotels, it should be kept in mind that to the greater portion of auto tourists it is the economy of the camping plan that makes possible to them the many advantages of travel. These visitors do not, therefore, represent a loss of custom to the local hotels.

The viewpoint of the taxpayer is cer-

tainly a variable quantity. There are "knockers" and "wet-blankets" in every community (they serve a useful purpose in providing obstacles for the "boosters" to overcome), and there are also many enthusiasts on tourist camps. All of these are taxpayers.

Properly located and maintained, a tourist camp need not interfere in any way with the routine of the individuals of a community. The cost to the taxpayer, moreover, need not be appreciable. Usually the municipality confines itself to furnishing the site (frequently a portion of a city park) with free light and water—properly leaving to the commercial men (often assisted by civic organizations) the development and maintenance of the camp facilities.

Careful investigations in certain western districts and cities have shown that in the average city the tourist camps easily pay their way ten to one in profits on local sales. Over 1,200 cars visited a certain western camp last August. Of these over 1,000 drivers filled out questionnaires which indicate that the local purchases of the average tourist party amounted to nearly five dollars per person. These purchases accrue to the benefit of many classes of merchants and, as they derive the financial benefit, it is only fair that they should assume most of the burden. Some of the most elaborate western camps are owned outright by commercial organizations.

Your conservatism in advising communities to go slow in developing tourist camps is hardly necessary in the case of the average town. What they usually need is encouragement of a more aggressive sort.

This is the situation. In most western and middle western states some sort of camping site is available within a few hours' drive from any point. Wide-awake commercial and civic organizations realize the value of the trade and the free advertising of the tourists, and are securing the good will of each transient by extending to him a hearty welcome and such service as he needs—finally sending him on his way a perpetual "booster" for such communities.

This means that a growing competition exists among communities in the matter of providing attractive accommodations. The town that is content simply to set aside a tract of ground and to erect a few signs welcoming the auto traveler will be "passed up" by a lot of traffic that might readily be encouraged to stop. Auto parties will often stop hours before dark where they notice the facilities of an attractive roadside camp. Unless a community is unusual as to location, isolation or points of interest, a conservative policy as to tourist-camp development can but result in losing most of its fair share of tourist patronage.

In constantly increasing numbers tourists are "taking to the road" in order to have the freedom thus gained as to route and schedule. The average auto tourist travels leisurely, frequently remaining for several days—or even weeks—in towns that offer him real hospitality and real service.

The tourist camp is a definite expression of the hospitality of the west, modified to meet the needs of the modern visitor who has selected the highway as the best way to see and to know the beauty spots of his country. It is a wonderful opportunity for service and good fellowship on the part of any community. It has proven to be a good business proposition, entirely aside from the advertisement of the community which thus gains new friends, new business and, frequently, new citizens.

In business and in advertising the aggressive policy, other things being equal, is the winning plan. So it is, as I see it, in the case of the development of tourist camps.

Very truly yours,

ROLLAND S. WALLIS,
Municipal Engineer,
Engineering Extension Department, Iowa State College, Ames, Iowa, June 30, 1922.

STANDARD FORM OF PUBLIC WORKS CONTRACT ADOPTED BY TEXAS SECTION AM. SOC. C. E.

By John B. Hawley, Consulting Engineer, 403 Cotton Exchange Building, Fort Worth Texas

(Editor's Note: Mr. Hawley was chairman of the Contract Committee that prepared the standard form of contract discussed in the present article.)

The usual contract between a City, County, or other political subdivision of a State, and the contractor who undertakes construction of public works is, and for generations has been, an instrument setting forth what the contractor must do, and what the other party may do. (You could almost put it "*may do to him.*"

The very word "contract" implies from

its Latin derivation that each party shall bring something, in equal shares, to the consummation of the undertaking. Mutuality of interest and responsibility, in the very nature of things human, are "of the essence" of the situation, a condition quite generally lost sight of.

Most public works contracts are so lacking in "mutuality," so "unilateral," "lop-sided," if you please, that the courts, when the issues are tried before them, brush the documents aside, (except for the mere matter of listed prices) and proceed to hear and determine the cause upon its merits.

The learned counsel who formulates the usual public works contract must have read Kipling's "Introduction" to "Regimental Ditties and Barrackroom Ballads," especially the stanza:

"Who shall doubt the secret hid
Under Cheops' pyramid,
Is that the Contractor did
Cheops out of several millions."

And with this as his inspiration drafts what more nearly resembles a Draconian code than an agreement to do and to pay.

Of late years engineers and lawyers who specialize in public works matters have become aware of the necessity for a form of contract that would provide something like mutuality. The attitude of courts, above referred to, has been somewhat an impelling cause.

National organizations have undertaken studies through standing committees and even sections of several societies have endeavored to improve conditions.

Among the latter, the Texas Section of the American Society of Civil Engineers has for several years worked upon a standard form of contract.

The Texas committee was composed of two engineers exclusively in the practice of engineering; two exclusively in contracting, and the chairman an engineer who for more than thirty years has actively practiced engineering with his time pretty evenly divided between service for municipal corporations and high-grade contractors.

The first draft, a form very closely following the one used by Mr. Daniel W. Mead in his private practice, was studied by each committeeman, who annotated it and sent it to the chairman. The several comments were noted on another draft and this remodeled form again submitted to all committeemen. This process was repeated several times until the committee were agreed upon a draft which was multigraphed and mailed to every member of the Society in Texas.

Comments and suggestions were sent in to the chairman by something like half the membership, and these collated and prepared for discussion by the committee. The committee met several times in various Texas cities, altered the form from time to time, but finally, in October, 1921, unanimously agreed to report a finished document to the annual convention of the Texas Section, held in Dallas.

The convention, on Oct. 28, 1921, unanimously adopted the form of contract as submitted by the committee and ordered 3,000 copies printed, to be furnished members and the public generally, at cost, which is 15 cts. per copy.

The committee drafted a foreword or preamble which accompanies each copy. It reads as follows:

"This Standard Contract Form was unanimously recommended by the Committee on 'Standard Form' and unanimously adopted by the Texas Section, American Society of Civil Engineers, at the Fall Meeting, Dallas, Texas, Oct. 28, 1921.

"The 'form' is the result of several years' research by individual members of the committee,and of their joint work in many meetings since October, 1920.

"Neither the Committee nor the Section believes the Contract to be the sole form suitable for every public works project, and it is not intended that it shall be forced upon the profession.

"It is, however, believed that the Contract is the best yet formulated for the administration of public works in Texas; that it is comprehensive, orderly and equitable in terms, and that its general adoption by members of the profession will result in saving millions of dollars annually to both OWNER and CONTRACTOR, by the elimination of hazards contingent upon less equitable contract forms."

As may be imagined, the arbitration clause was the subject of most prolonged discussion and most earnest debate by the committee and membership at large. Engineers have so long been accustomed to considering their rulings on any point as "final and binding" on both parties to a contract, that any proposal to limit their powers, even by so obviously fair and equitable a means as arbitration, at first blush seemed an affront, as one "old-timer" expressed it, "contempt of court." Like all other provisions of the committee's form, however, the arbitration clause was unanimously adopted.

(In Texas and many other states a city may not lawfully sign away its rights to its "day in court." Consequently the arbitration clause has the following proviso: "The decision of the arbiters upon any question submitted to arbitration under this contract shall be a condition precedent to any right of legal action. The decision of the arbiters may be filed in court to carry it into effect.")

The eminent lawyers, specialists in public works contracts, employed by the committee, favorably passed upon the arbitration clause as, in fact, they passed upon the complete form.

The arbitration clause is doubtless the most important feature of the document.

Only those who have had long and intimate contact with the contractor's side of public works life are aware of the apprehension, trepidation, suspicion, if you please, with which an experienced, prudent contractor formulates his proposal for the construction of a good-sized piece of public works, the direction of which is to be in the hands of an engineer whose reputation for fairness is either unestablished or dubious.

This apprehension manifests itself in very substantial, material form as a percentage, included in each unit bid, to cover "the hazard of the engineer."

The arbitration clause will eliminate the fear of unjust rulings by the engineer, and by the same token, the percentage added to cover that "hazard." One of the most experienced (and respected) engineers in the South estimates that the Texas standard contract form will save at least five per cent on the cost of all public works.

In Texas alone this would mean $5,000,000 annually saved the public.

It is to be hoped that other state sections of the great societies and finally the parent bodies will follow the way marked out by Texas and adopt standard contract forms that will equally protect the rights of "both parties hereto."

It is not practicable, because of space limitations, to reproduce the contract form in full in this article. However, the scope of the document is well indicated by the following headings listed on the index page.

Bond; general conditions of the agreement; notice to bidders; preface; proposal; standard form of agreement; abandonment by contractor; abandonment by owner; arbitration; assignment and subletting; bond; changes and alterations; character of workmen; collateral contracts; contractor; contractor's agent; contractor's buildings; contractor's duty; construction plant; damages; defects and their remedies; delayed payments; discrepancies and omissions; engineer; engineer's authority and duty; estimated quantities; exhibits; extension of time; extra work; final acceptance; final payment; hindrances and delays; interpretation of phrases; liquidated damages for delay; lines and grades; losses from natural causes; owner; partial payments; penalty and bonus; plans and specifications—keeping accessible; preliminary approval; price for work; protection against accident to employes and public: protection against claims for labor and material; protection against royalties or patented inventions; protection of adjoining property; quantities and measurements; right of entry; right of engineer to modify methods and equipment; sanitation; superintendence and inspection; time of filing claims; time and order of completion.

The arbitration clause, the most important feature of the contract, follows in full:

Arbitration

"All questions of dispute under this Agreement shall be submitted to arbitration at the request of either party to the dispute. The parties may agree upon one arbiter, otherwise, there shall be three; one named in writing by each party, and the third chosen by the two arbiters so selected; or if the arbiters fail to select a third within ten days, he shall be chosen by..... Should the party demanding arbitration fail to name an arbiter within ten days of the demand, his right to arbitrate shall lapse, and the decision of the ENGINEER shall be final and binding on him. Should the other party fail to choose an arbiter within ten days, the ENGINEER shall appoint such arbiter. Should either party refuse or neglect to supply the arbiters with any papers or information demanded in writing, the arbiters are empowered by both parties to take ex parte proceedings.

"The arbiters shall act with promptness. The decision of any two shall be binding on both parties to the contract. *The decision of the arbiters upon any question submitted to arbitration under this contract shall be a condition precedent to any right of legal action.* The decision of the arbiter or arbiters may be filed in court to carry it into effect.

"The arbiters, if they deem the case demands it, are authorized to award the party whose contention is sustained, such sums as they deem proper for the time,

expense and trouble incident to the appeal, and, if the appeal was taken without reasonable cause, they may award damages for any delay occasioned thereby. The arbiters shall fix their own compensation, unless otherwise provided by agreement, and shall assess the cost and charges of the arbitration upon either or both parties. The award of the arbiters must be made in writing, and shall not be open to objection on account of the form of proceedings or award."

QUANTITY SURVEY SERVICE IN THE PUBLIC WORKS FIELD

By William E. Skinner, The Associated Engineers, Inc., Engineers, Constructors, Managers, 86 Michigan St., Milwaukee, Wis.

The Quantity Survey System has been advocated since 1891 by Mr. C. Alexander Wright, A. I. A. of San Francisco, who is the founder of the movement to adapt the Quantity Survey System to American building practice. It has attracted much attention among contractors, architects and engineers, and in the course of time this system of estimating must be adopted as it stands for a square deal between the owner and the contractor.

The quantity survey system has been in use in Europe and particularly in England, France and Germany for many years, and it has also been used in the United States to a limited extent on some classes of work for a considerable period of years, but it is only within the last three years that there has been a quantity survey bureau in this country which was prepared to handle the various classes of this work, as was offered to it.

The railroads have for years required a detailed bill of material on their construction projects, and the highway work of the country is let on a basis of so much per cubic yard for excavation, so much per square yard for surfacing, and the amounts of excavation and surfacing in nearly all cases are calculated and stated so that the bidders on these classes of work have had the benefit of a virtual quantity survey.

The Quantity Survey Defined

The quantity survey is a bill of material taken from the plans and specifications, but is not, as many people have supposed, merely the taking off of a list of items by one person, probably with uncertain accuracy, for some other person's use. It means the careful measurement by a disinterested expert who proceeds in a manner quite different from that of the average contractor. He uses some recognized order and system in taking off the quantities, abstracting and billing, with a view to the elimination of errors, and he expresses these quantities in certain uniform standards of measurement, and expressions well understood by the bidders; and his checking and rechecking methods, to insure accuracy, must be studied to be appreciated by those to whom the quantity system is unknown.

Such a quantity surveyor, in taking off quantities from an architect's or engineer's drawings, readily detects any discrepancies due to hasty preparation or other cause. By means of this co-operation the attention of the architect or engineer is called to such matters by the quantity surveyor as he goes on with his work, thereby eliminating uncertainties in the plans and specifications.

The result of the quantity survey is then blue-printed, mimeographed, or otherwise reproduced, and a copy supplied to each bidder, who has only to insert his prices opposite the items and put up the totals. To quote Kidder, "This is really all that contractors should be expected to do (for nothing)."

Many people are under the misapprehension that the contractor makes his estimates on the various jobs for nothing; that is to say, that the owner does not pay the contractor for making those estimates in the course of preparation for their bids; but the modern contractor includes in his overhead, which he charges against the job that he gets, not only the cost of estimating that particular job, but also the cost of estimating the jobs that he did not get. From the foregoing it can be readily seen that the method, while painless to the owner, is yet withal both costly and wasteful, and occasions a large amount of duplication of effort on the part of the various contractors.

15 Advantages Claimed for Quantity Survey System

The advantages claimed for the quantity survey system are so well set forth by Kidder's Architects' and Builders' Handbook (17th Edition), which is in use in the majority of the architects' offices as a reference book, that I do not believe I can do better than to quote the following 15 advantages claimed for the system:

(1) An immense saving of time and

money now wasted by bidders; all doing the same thing, going over the same ground, and each arriving at a different result.

(2- Safer bids, as the work to be performed is clearly written out in the bill of quantities, which can be the essence of the contract.

(3) No expense to the bidder; the owner pays for the quantities knowingly. The owners pay now, but this fact is not brought to their attention, and it does not occur to them. The percentage added to a bidder's net cost is not all profit, a certain portion being absorbed in overhead charges, including cost of estimating which, of course, is ultimately borne by owners.

(4) Savings of disputes arising from ambiguities, oversights, and even errors, all causing extra claims more or less just, but usually vexatious, and sometimes embarrassing.

(5) Better opportunities for the competent bidder, as the bidders all work up and price from the same basis.

(6) Better work and greater harmony. If no part of the work is omitted there is less reason to skin the work, a proceeding which produces friction, or worse.

(7) Misunderstandings are reduced. The bill of quantities states clearly what is intended, and is a sort of clearing-house for the drawings and specifications.

(8) Neither party can obtain an advantage over the other on quantity or description of work.

(9) No disputes with sub-bidders, it being clearly stated what each trade is to furnish.

(10) Contractors have no figuring of quantities to do and can therefore devote more time to buildings in hand and save profits now lost for want of their personal supervision.

(11) Fewer inferior contractors as lowest bidders.

(12) Fewer extras, which are usually a trouble to all concerned.

(13) The architect or engineer has the assistance by collaboration of the professional quantity surveyor, who is available, also, for preliminary figures. This advance information, now so often furnished by a prospective bidder, creates undesirable obligations.

(14) No change or reorganizing of architects' office is entailed. Much detail work now involved in receiving bids could be taken care of in the quantity surveyor's office.

(15) The drawings and specifications having been previously made as complete as possible, subsequent inconvenience to contractors and foremen on the job, and inquiries at the architects' offices for explanations become unnecessary. The *Bill of Quantities* gives detailed information which cannot be well given by drawings.

Value of Quantity Survey Illustrated on Manitowoc, Wis.

By reason of the foregoing advantages one can easily see that there should be some financial benefit derived by the public in using a quantity survey of public work. Only recently the School Board of the City of Manitowoc, Wis., took bids on a proposed high school for the city, and a study of the bids submitted shows the following interesting result:

The two lowest bidders had the advantage of a special check on the general contract items prepared by the firm, with which the writer is connected, and their bids were, in round figures, $379,000 and $384,000, while the next two bidders above did not take advantage of any such check, and their bids were $417,000 and $442,000, leaving a difference of approximately $35,000 or about 9%, between the bidders who had a check and were, therefore, able to figure more closely than the bidders who did not take advantage of such a check on their estimates. The average fee charged for making a quantity survey is based on one-half of 1% of the cost of the project, which, in this instance, would have amounted to only about $2,000.

From the examination of a considerable number of jobs where quantity surveys have been prepared on the general contract at the specific request of some bidder, the above results have been so uniformly the case that there is no question in my mind but that the quantity survey was responsible for the major part of that saving.

When the quantity survey is used on a job it should be guaranteed by the owner, and even in event of the quantity surveyor having made an error in his figures there is no damage done, since the bids are based on the amounts of material shown and the result in such a case would be merely the adding or subtracting of an amount of material at the rates given in the bid.

The Building Council of New York City has a special committee which at the present time is making a thorough study of the quantity survey work as handled by the different quantity survey bureaus

throughout the country, with a view to establishing uniform service. This committee has, so far, learned of the existence of quantity survey bureaus in Boston, New York, Baltimore, Chicago and Milwaukee, and it is probable that there is also a bureau at Minneapolis.

The efforts of the quantity survey bureaus of this country to have the quantity survey furnished to go with the plans and specifications, as furnished by the owner to the bidders, is gradually meeting with success, and it is fair to assume that not many years will pass until this practice becomes universal in this country, as a result of the demands made upon the construction industry to eliminate waste and proceed in the most economical manner.

THE ENGINEERING EXPERT WITNESS AND TECHNICAL ADVISER

By Paul E. Green, Consulting Engineer, 1002 Wrigley Bldg., Chicago, Ill.

In the vast development of our modern city a wide field has evolved in which the expert technical witness and consultant is in active demand. Many of our states require that certain classes of municipal work, particularly those in which the cost is assessed against property benefited, should have court hearings before the assessment is finally legalized. At these court hearings, if it is shown that the work has been improperly or extravagently designed or constructed, it may occur that the proceedings are annulled because the improvement becomes an unreasonable one. It frequently happens therefore, that the assessment is attacked by protesting property owners, and along these lines it is necessary for the city to establish, by competent expert engineering testimony, that the design is reasonable and good and that the construction has complied with the specifications.

Many cities having competent city engineers, find that because of his closeness to the public and to the city officials, the engineer does not always receive the confidence which he deserves. The consulting engineer and expert therefore is frequently called in to advise in the design of these various improvements and in addition may be called in to defend the design in court, or to advise the City Engineer and the Attorney as to drawing of the correct legal documents which cover the engineering phases of the work.

The benefits to be derived by the client from such work, provided the choice of the consulting engineer has been a happy one, are large. The city goes ahead more confidently with the improvement because its design has been carefully checked by a disinterested expert, the attorney is more fully advised as to the technical details, the city engineer draws his plans more carefully because he knows that they are being checked and supervised by another engineer, and the public being informed that the city has retained a consulting engineer has the feeling that its interests are more fully protected than they might otherwise be. This condition applies not only to the smaller cities but to the largest ones, also. Many of the city engineers of the smaller towns have graduated from the ranks of the surveyors. They are often first class mathematicians and their experience is broad as to amount of work which they have done in that particular locality, but limited as to the whole field.

After a scheme has once been adopted the consulting engineer is particularly valuable in court trials, not only as an expert witness but as a technical adviser to the attorney. This is a broad field for consulting engineers but not all consulting engineers, no matter how able, are suitable for this class of work. Some of the most able engineers with whom the writer has been acquainted have made the poorest witnesses and advisors in trials of this character. The reason is, not that they have not the knowledge but that they have not the ability to impart this knowledge to the court, jury, or to the attorney, do not make positive statements, or assume an intolerant attitude.

For the expert witness there are many dangers to be avoided. He must not be too technical, otherwise his testimony is likely to be ignored as being a purely theoretical statement not backed by practical experience. In addition an extremely technical witness tires both court and jury. Sufficient technical knowledge and experience should be shown to qualify thoroughly but finely drawn deductions should be avoided.

Another fault of many technical advisers is that many engineering experts tend to lean backward in their testimony. Their thought seems to be that they must be judicial and very conservative in their statements, even to the extent of accepting some part of an adverse conclusion (which may have been considered and rejected because of their own judgment of the matter) in order to show their

fairness. It should be borne in mind that the technical expert, while he is expected to be correct and fair in his statements, is employed to defend a particular scheme and design and that he should assemble the valuable points for his client and combat unfavorable ones. It is rare that there are not two sides to a case and that alternative designs may not be introduced that are very nearly as meritorious as the one which he is supposed to advocate. But the witness that is not positive in his statements and sure of his ground is an actual detriment to the side which he represents. An expert should be an impartial judge in originating and advising as to the design and in deciding between two or more designs. But one having made a decision based on his best knowledge and ability he should defend it vigorously. He should not exaggerate but he should also not under rate the merits of his scheme.

It seems to the writer a not unimportant point is that it is essential for a high class professional witness to present a good appearance in a court case. This means that he should be well dressed, that he should not be the rough and ready type and that it is essential that his testimony should be scholarly and polished as well as practical. Such a combination adds to the value of the witness for primarily the engineer in such cases is there as an advocate of his client's interests in the same manner as is the attorney. On the stand he should not argue with his attorney or the opposing attorney and above all things before he accepts a commission to act in this capacity he must believe in his own case. A smooth speaking, pleasant, technical witness who does not get excited, angry or make exaggerated statements is almost unbeatable.

When an engineer is retained to assist an attorney in a technical case he should not confine his work to the court room alone, otherwise he will probably find that his testimony and advice is worse than useless. In other words he must be adequately prepared. Probably in most cases the bulk of the work which he will do will be outside of the court room. He must make a close study of the law which covers the improvement so that if other and opposing technical witnesses are examined he may be able to assist the attorney in pointing out weak spots in their testimony. He should make a thorough study of the location of the improvement and a minute detailed study of the design even if he has had nothing to do with it in its original form. Not only should he make the study of this design, but he should carefully examine alternatives so that he may be able to forestall objections to the design which is being examined in court, and to bring out the strong points of his own case. He must very fully advise the trial attorney on these matters, in fact he should come pretty near educating the attorney or attorneys along the technical lines which are required in the particular case. From his client he must insist on complete data or that he be given sufficient time to accumulate the data. Nothing is more fatal than to go into a case of this kind without complete information. It may be taken for granted that the other side will supply it to him in the shape of unfriendly witnesses if he does not have it.

Frequently diagrams and drawings are needed, both for the information of the court and for the jury in case it is a jury trial. These diagrams should be made to a large scale and the mooted points shown in strong colors. Several copies of each of such diagrams should be available not only for the court but for the opposing attorneys, engineers, and for his own witnesses. In an important case the engineer should insist that the testimony be written up each day and this testimony he must very carefully and thoroughly study. If the testimony of the opposing technical witnesses is complicated he should request his attorney to defer cross examination for the time being until such testimony can be read and studied, otherwise he is almost certain to overlook important points.

Finally after the testimony of both sides is in the time for argument arrives. At this time the engineer should be particularly valuable to his client. If he has properly studied the case he has tabulated all the important points and discussed them with his attorney. The writer has found it to be a valuable and helpful practice to argue and present the case, as it appears to him, to his attorney in the same manner that the attorney will later argue to the court. In this way the trained legal intellect of the attorney is pitted against his own engineer for the purpose of strengthening the case. Valuable points are brought out and the attorney is able to see the case more clearly because of the argument than he otherwise would and thus more clearly to present it to the court and jury in his own statement.

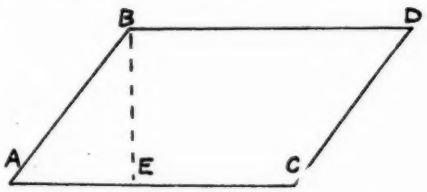
A MODIFICATION OF THE VICARI METHOD OF DETERMINING MAXIMUM RUNOFF

By Kenneth Allen, Santitary Engineer, Board of Estimate and Apportionment, Municipal Bldg., New York, N. Y.

The usual procedure in determining runoff to sewers by the rational method is often tedious, especially where maximum volumes occur from storms of shorter duration than the period of collection.

In Engineering News, Nov. 5, 1914, Mr. O. Hufeland described a graphic solution of the problem which it is understood originated with Vicari at Milan and was later expounded by various German authorities. A full description of the method may be found in Hutte's Handbook and a synopsis is given in an article by Wynne-Roberts and Brockmann in The Surveyor and Municipal and County Engineer of April 18, 1913, so that any detailed analysis is unnecessary here.

In brief, however, a diagram is constructed by superimposing a series of rhomboids, each of which corresponds to a drainage sub-district. Each rhomboid is constructed by laying off:



A E=time of collection in minutes.

B E=rate of runoff in cu. ft. per sec. when the entire area is contributing.

A C=B D=duration of downpour.

With these superimposed rhomboids so located that any ordinate represents the same time in each—that is, so that the rhomboids for all sub-districts whose flow is combined at one point have the same abscissa—the maximum flow in the sewer will correspond to the maximum ordinate intercepted by the series of rhomboids.

The weak point in this solution lies in the uncertainty as to what duration of downpour to assume. Vicari seems to leave this to the arbitrary selection of the computer. An improvement would seem to lie in using the period of collection. Probably a yet better plan would be that suggested by R. D. Goodrich in a discussion of Mr. Hufeland's article (Eng. News-Record, Dec. 31, 1914), namely: After combining the intercepts on each ordinate so as to smooth out the jagged line formed by the sloping edges at the left of the figure (which rectified line will then represent the increment of discharge at the selected point during the first part of the downpour) lines parallel to this rectified line are drawn at intervals representing, say, five minutes to the right of the first. These lines then represent the diminution of runoff at the ends of these 5-minute intervals, the duration of downpour being measured by the horizontal distance between each rectified line and the first one. The ordinate intercepted between any rectified line and the first one which shows the maximum volume of runoff indicates by its abscissa the time when such maximum occurs, and the part of the abscissa intercepted by the two rectified lines represents the duration of downpour causing this maximum rate.

This duration may or may not be equal to the time of collection, depending on the shape and slope of the watershed area, but it is never greater. Likewise, the runoff can be found by measuring the ordinate intercepted between the two rectified lines for any part of the sewer system and for any time after the first of the downpour without the further construction of diagrams or computation.

The diagram shows the probable maximum runoff from the West 98th street drainage area in Manhattan. The runoff coefficient is assumed, for purposes of discussion, as 100 per cent, and the rainfall intensities those corresponding to the formula given below.

The jagged line on the left, shown rectified in the heavier line, indicates the beginning of the storm or downpour. The parallel rectified line indicating the end of a 4-minute storm is shown to the right, and the maximum ordinate intercepted between the two represents the maximum runoff with a storm of this duration.

The diagram, which was first plotted by Mr. Hufeland, was based on the observed fact that in a certain storm an intensity of 4.8 ins. per hour was maintained for four minutes and a scale of ordinates of 20 cu. ft. runoff per second to the inch was adopted. Applying the intensity formula $I=\frac{150}{t+16}$ (recommended in 1913 by the Committee on Rainfall and Runoff of the Municipal Engineers of the (City of New York to the diagram, by which a rate of 7.4 ins. per hour may be expected once in 10 years, each inch represents $\frac{7.4}{4.8}\times 20=30.9$ cu. ft. per second,

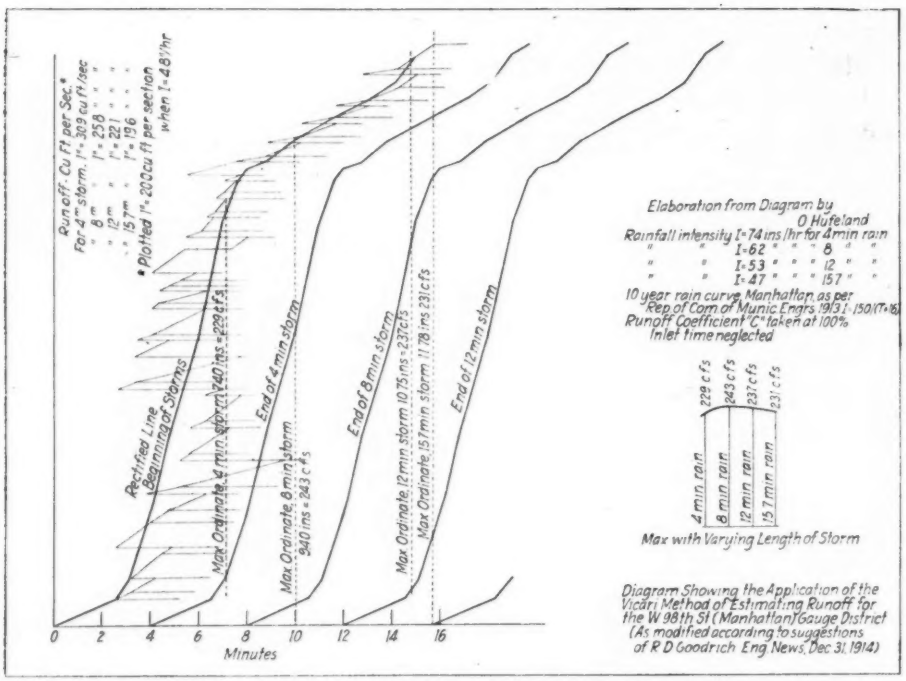

Runoff - Cu Ft per Sec.*
For 4 min storm I = 309 cu ft/sec
" 8 " " I = 258 " " "
" 12 " " I = 221 " " "
" 15.7 " " I = 196 " " "
* Plotted I = 200 cu ft per section when I = 48"/hr
Rectified Line Beginning of Storms
Max Ordinate 4 min storm 240 ins = 229 cfs
End of 4 min storm
Max Ordinate 8 min storm 240 ins = 243 cfs
End of 8 min storm
Max Ordinate 12 min storm 10.75 ins = 237 cfs
Max Ordinate 15.7 min storm 11.78 ins 231 cfs
End of 12 min storm
0 2 4 6 8 10 12 14 16
Minutes
Elaboration from Diagram by O Hufeland
Rainfall intensity I = 74 ins/hr for 4 min rain
" " I = 62 " " " 8 " "
" " I = 53 " " " 12 " "
" " I = 47 " " " 15.7 " "
10 year rain curve Manhattan as per Rep of Com of Munic Engrs 1913 I = 150/(T+15)
Runoff Coefficient "C" taken at 100%
Inlet time neglected
229 c f s
243 c f s
237 c f s
231 c f s
4 min rain
8 min rain
12 min rain
15.7 min rain
Max with Varying Length of Storm
Diagram Showing the Application of the Vicari Method of Estimating Runoff for the W 98th St (Manhattan) Gauge District (As modified according to suggestions of R D Goodrich Eng News Dec 31 1914)

DIAGRAM SHOWING APPLICATION OF MODIFIED VICARI METHOD OF ESTIMATING RUNOFF FOR W. 98th ST., MANHATTAN GAUGE DISTRICT.

and the measured intercept represents 7.40x30.9=229 cu. ft. per second runoff.

Repeating this with the rectified line for an 8-minute storm the maximum intercept is found to be 9.40 ins.; and as the intensity formula gives a value of I=6.2 ins. per hour, the intercept corresponds to $\left(\frac{6.2}{4.8}x20=25.8\right) \times 9.40=243$ cu. ft. per second.

Similarly, for a 12-minute storm the maximum runoff is shown to be 237 cu. ft. per second, and for a 15.7-minute storm (15.7 minutes being the time for collection), 231 cu. ft. per second.

The sewer capacity, therefore, should be based upon the flow from an 8-minute storm, amounting to 243 cu. ft. per second.

The Vicari method, thus adapted to the practical solution of runoff problems, is not as difficult to grasp as to describe, and those intending to make use of it should consult one of the articles referred to above. It has the advantage of providing a rational result at any period of a storm of any duration and for any combination of subdistricts desired, practically without computation, tabulation or other work after the diagram has once been constructed. Whether or not it should be substituted for the usual method, involving computation and tabulation, depends upon the specific problem in hand and on the personal preference of the engineer, but it has been thought of sufficient value to be presented in this way for consideration.

FEATURES OF STATE HIGHWAY WORK IN MONTANA

By John N. Edy, Chief Engineer, Montana Highway Commission, Helena, Mont.

The outstanding features of the present situation in respect to highway improvemen work in Montana are as follows:

State Maintenance

For the first time in its history, the state will this year participate in the cost of and assume full responsibility for the maintenance of state highways improved under the supervision of the state highway department. Compared with the whole road mileage of the state, the mileage of state-maintained roads for this year will be very modest indeed. However, a start has been made along lines which are now recognized as proper and reasonable and state maintenance of important state highways will undoubtedly be a fixed policy from this time forward.

Maintenance will be accomplished by

means of patrolmen or section men under direct supervision of the state's maintenance division. No maintenance by contract is contemplated at this time.

1922 Construction Program

The volume of new work proposed for 1922 is considerably under the average for the past two years. This is due largely to the fact that county bond issues, which have been used by the state as a source of local funds to match Federal Aid, are very nearly exhausted. Since the department is going into the new season with less than a million dollars of uncompleted contracts the outlook for a summer of heavy work is not very promising. No contract lettings have been held this spring, although several small gravel road projects will be advertised soon.

In all probability the value of construction work accomplished during the 1922 season will not exceed two and one-half million dollars.

Suspension of Paving Activities

While this department has never built a considerable mileage of paved roads it is now planned to suspend all such activities for at least one year. There are several reasons for this policy. In the first place it is recognized that not over one hundred miles of Montana's sixty-seven thousand miles of public highways need to be improved at this time to a standard beyond that of a well built gravel road. Montana's road problem is decidedly one of securing maximum mileage, at a minimum cost, if necessary to the disregard of many of the refinements of location and design.

Again, the present and immediate future practice of the department will require that all paved road surfaces, whether of concrete or of bituminous concrete, shall be placed upon a sub-base of gravel or other suitable material. In connection with such applications for paving projects as may be received therefore the department will complete grading and drainage features as soon as possible and place a relatively thin wearing surface of gravel, which will serve the traffic adequately for the time being and offer a suitable foundation for the pavement when it is constructed.

State Funds for State Road Projects

Last fall it was thought that the department would promote a state road bond issue for submission to the people at the general election of this year and by means of which state road projects could be financed. Conditions in the state, however, have been such as to cause the department to abandon this program entirely. It is now believed that the only possible source of state revenue lies in a reasonable increase of motor vehicle license fees and an increase in a gasoline tax which is now 1 ct. per gallon. It should be noted, too, that the proceeds from the gasoline tax are now credited to the general fund of the state and it is proposed that the proceeds from this tax be made available for state highway improvements. While the department recognizes that many persons other than actual road users are benefited, either directly or indirectly, through the development of an improved state highway system, it is nevertheless a fact that for some time in the future the people who use Montana's highways must pay for their improvement

Volume of Traffic

The volume of trafic using Montana's roads is light, some of the most important interstate roads showing a maximum summer traffic of about 500 vehicles per day. In the vicinity of Butte, the largest city in the state, one road carries a traffic of approximately 2,000 vehicles and another a traffic of approximately 1,500 vehicles. In general this traffic consists of pleasure cars ,the maximum truck traffic on any highway in the state rarely exceeding 200 per day.

Federal Aid

All the work built by the department since 1919 has been with Federal Aid; Federal funds being matched with county funds. The state has had no money for construction. In 1921 the department received approximately $275,000 from motor vehicle fees, which was barely sufficient to carry the administrative and engineering charges of the department.

MANUAL OF OPERATION FOR USE IN MAINTENANCE OF LOUISVILLE SEWERS

By Ruth Canavan, Librarian for Metcalf & Eddy, Consulting Engineers, 14 Beacon St., Boston, Mass.

Recognizing that adequate service of a sewer system can be insured only by its maintenance in proper operating condition, the Commissioners of Sewerage of Louisville have had published in separate form Appendix G of a recent report by Chief Engineer J. B. F. Breed and Consulting Engineers Metcalf and Eddy. This appendix, entitled "Manual of Operation and Maintenance of Sewer System, Louisville, Ky., October, 1921," is of pocket size and durably bound in canvas. In it are

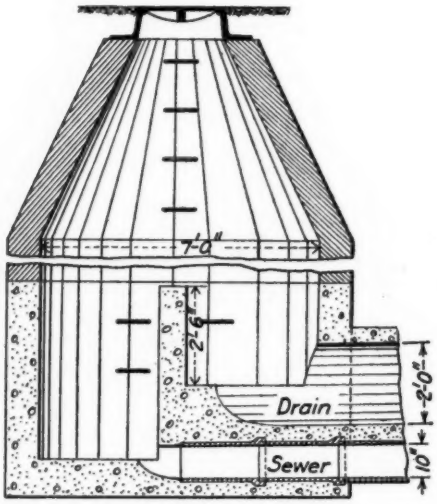


FIG. 1—SPECIAL MANHOLE ON ALTA AVENUE SEPARATE SEWER AND DRAIN, LOUISVIILE, KY.

included sections on the following subjects:

Care of Sewers and Drains,
House Connections,
Inlets,
Catchbasins,
Inverted Siphons,
Regulators,
Flood Gates,
Special Manholes,
Diversion Chamber,
Overflow Chamber,
Outlet Structures,
Gauging Chamber,
Beargrass Creek Channel.

The Manual also contains definitions of the various features of the sewer system and illustrations of typical and of particular structures.

In several instances special manholes have been found necessary, to meet unusual conditions for which the standard form was not suitable.

"Where a separate sewer and a drain are constructed side by side, or one above the other, a special form of manhole may be required, such as that shown in Fig. 1, which is on the Alta Avenue sewer. By drawing together the two compartments into a single shaft access is provided to both lines of pipes, with but a single cover in the street. In this case the drain is above the sewer and the division wall is provided to prevent the flow in one pipe, when operating under slight pressure, from passing over into the other. Unless the drain is maintained free from obstruction due to deposits or other clogging materials, there is danger that the storm water will overflow the wall and surcharge the sewer. Similarly the sewage may overflow into the drain, through which it may flow into one of the water courses and cause objectionable conditions. It is important, therefore, that

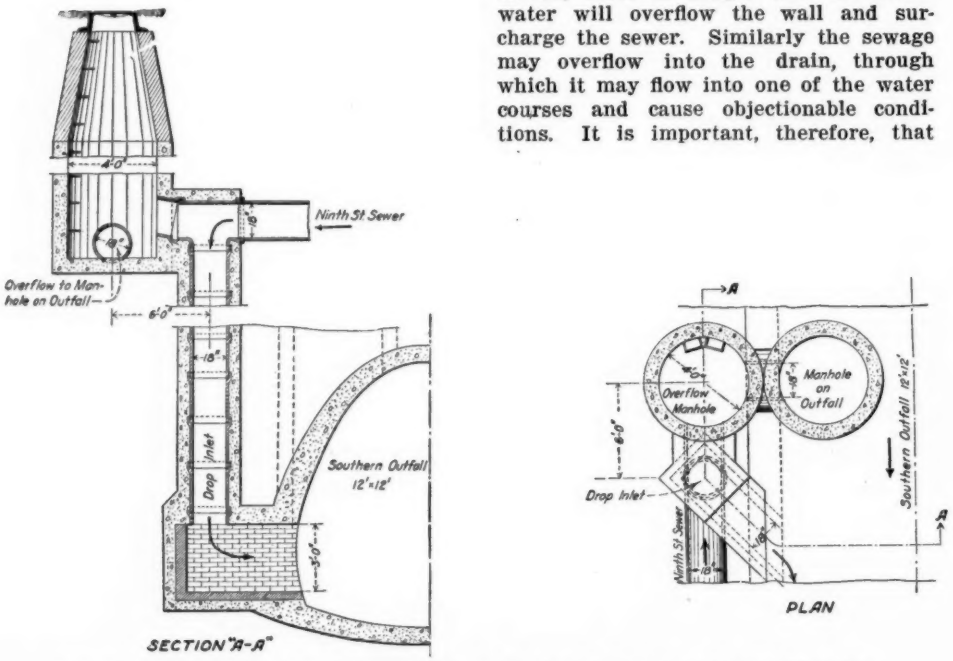


FIG. 2—DROP MANHOLE ON THE NINTH STREET SEWER, LOUISVILLE, KY.

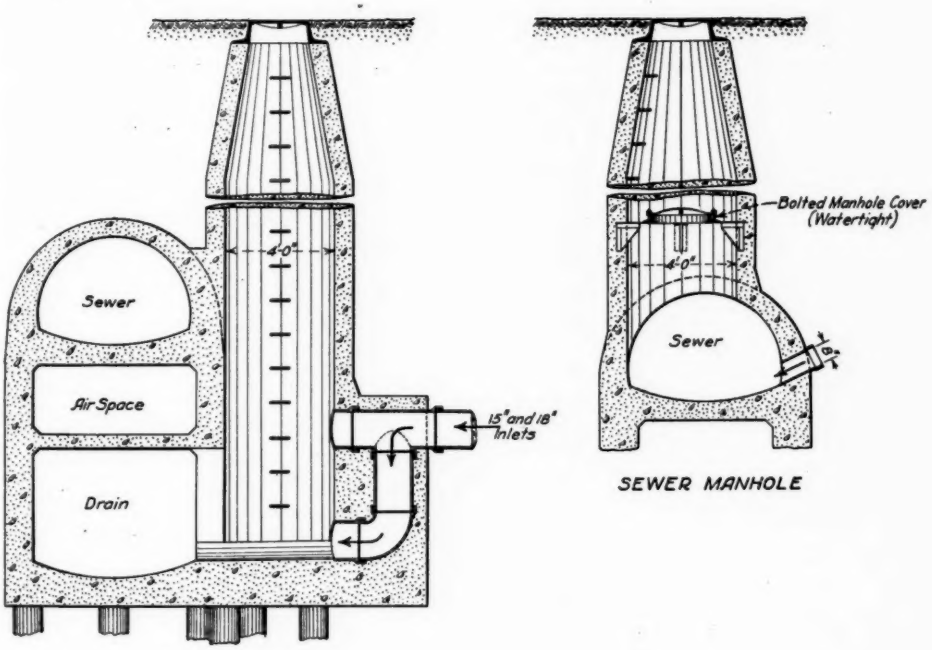


FIG. 3—TYPICAL MANHOLES ON THE NORTHEASTERN SANITARY TRUNK SEWER AND STORM DRAIN, LOUISVILLE, KY.

sewers and drains upon which manholes of this type have been constructed be inspected at frequent intervals, so that any obstruction may be discovered and promptly removed."

In cases where there is especial danger of overflow from one pipe into the other, separate manholes have been built.

Three drop manholes are also described, that on the Ninth Street sewer, Fig. 2, including provision for resisting erosion of the bottom due to the action of falling water, and others on Beargrass interceptor and the Northeastern Sanitary trunk sewer, where they pass through the district known as the Point, having been so constructed

"* * * as to prevent water from the river passing back through the sewers, overflowing the manholes and flooding the low ground behind the cut-off embankment. In some cases the manholes were simply constructed to a height equal to, or greater than, that of the embankment, and in others a diaphragm was provided (Fig. 3). The bolted diaphragm covers should be kept bolted down. The bolts and nuts should be kept greased so that the covers can be removed readily, and the metal work should be cleaned and painted at least once a year."

Eight pages of the Manual are devoted to "Inverted Siphons," that on Section A, Northeastern Sanitary Sewer (Fig. 4), being described as follows:

"This inverted siphon is constructed with three lines of pipe—one 18 ins. and two 30 ins. in size. The inlet chamber contains sluice gates controlling the flow into each of the siphon pipes, also a sluice gate opening into an overflow chamber. This latter gate should be closed except in an emergency. * * *

"If the flow of sewage reaching the inlet chamber is greater than the combined capacity of all three pipes, due to clogging or other reasons, the sewage will pass over into the emergency overflow and be discharged into Beargrass Creek.

"A clean-out chamber has been provided at the low point in the siphon, so that any one of the three pipes can be drained out. Sewage discharged into this clean-out chamber must be removed by pumping, to facilitate which a sump has been provided. In case it becomes necessary to enter any one of these pipes, and the work cannot be done through either the inlet or discharge end, a section of flanged pipe, located in this chamber, can be removed, thus providing access to any one of the siphon pipes at the low point."

A siphon consisting of a single line of 8-in. pipe, the flow of which is controlled by a regulator at the inlet end, is located on the Cooper Street sewer connection. On this siphon, also, a clean-out manhole has been provided, through which the siphon passes in the form of a flanged

carry the dry weather flow only, is illustrated by Fig. 5.

In the section devoted to outlets five structures are described, perhaps the most interesting being that of the Southern outfall sewer (Fig. 6), because of its fall of 34.2 ft. in a length of but 93 ft.

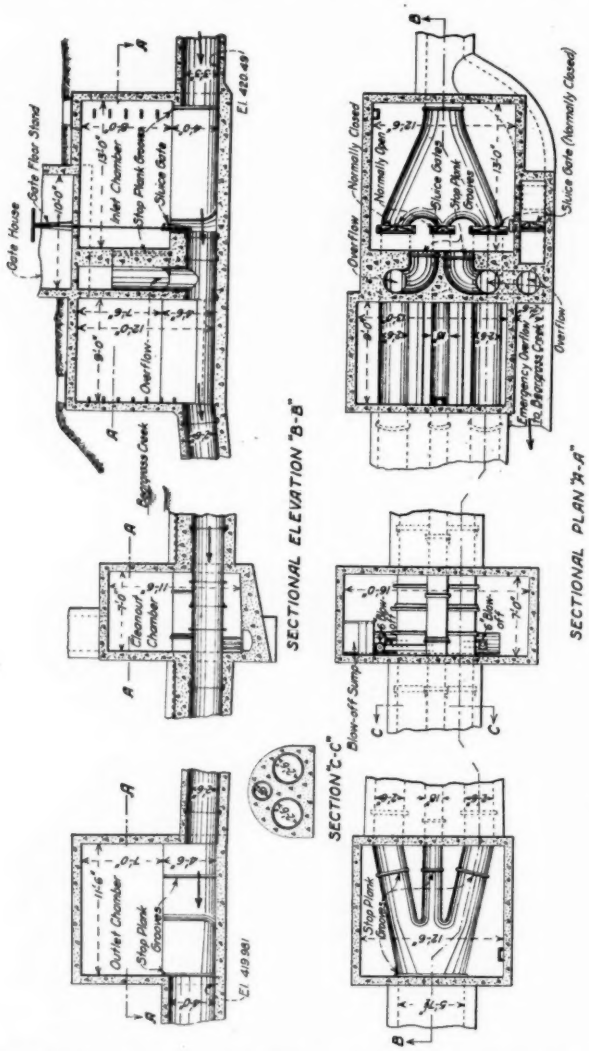


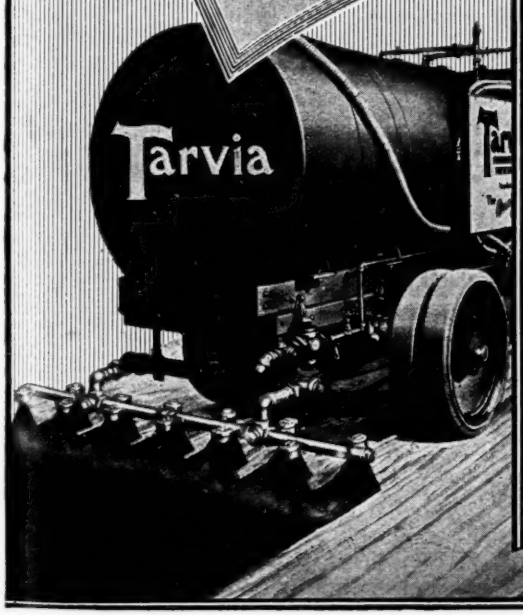
FIG. 4—INVERTED SIPHON ON SECTION A, NORTHEASTERN SANITARY SEWER, LOUISVILLE, KY.

cast-iron pipe. By the removal of one or more sections of this pipe access can be obtained to the straight run of pipe. An 8-in. gate valve in the manhole prevents entrance of backwater from Beargrass intercepter at times when the siphon is out of service for repairs or due to emergencies. This siphon, which is designed to

The dry weather flow channel, or cunette, in this section, is 3 ft. wide in the invert of the large sewer, and is lined with vitrified clay channel pipe.

"The remainder of the invert is lined with vitrified brick up to the beginning of the arch. Insofar as practicable, obser-

A prominent engineer writes: "Your 'Maintenance Manual' is the most constructive piece of road literature that has come to my attention in years. Congratulations."



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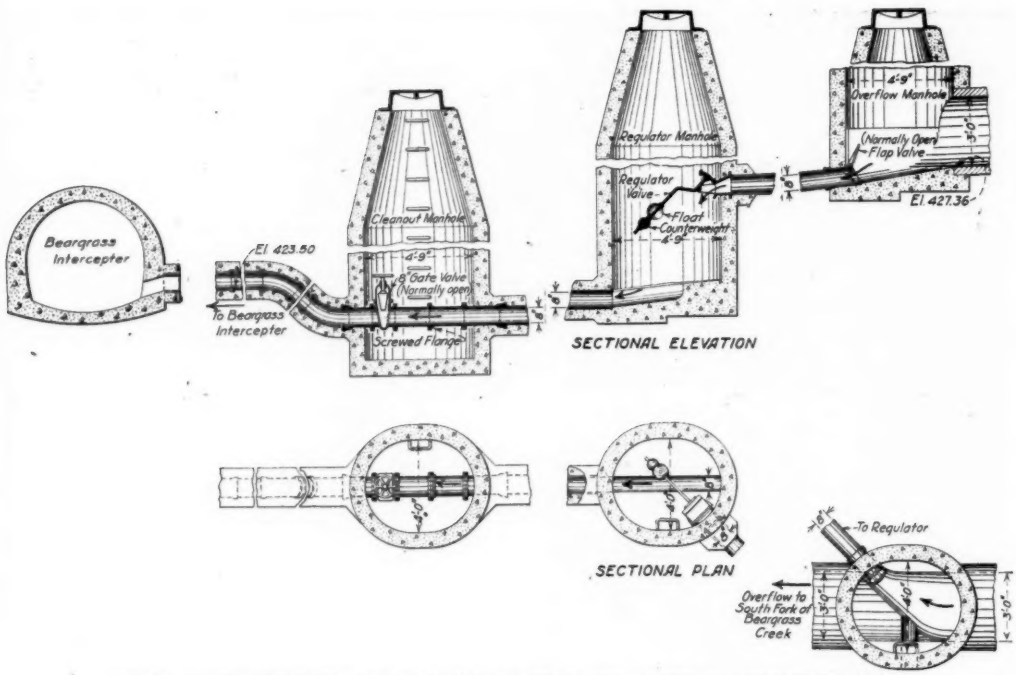


FIG. 5—INVERTED SIPHON ON COOPER ST. SEWER CONNECTION, LOUISVILLE, KY.

vations should be made from time to time to make sure that these linings are intact and have not been broken or worn by the flow. If required, repairs should be made promptly.

"The elevation of the crown of the outlet is * * * 5 ft. below the 9-ft. stage of Ohio River. * * *

"The foundation of the outlet is carried down to rock to guard against possible movement of the structure due to the sliding of the bank."

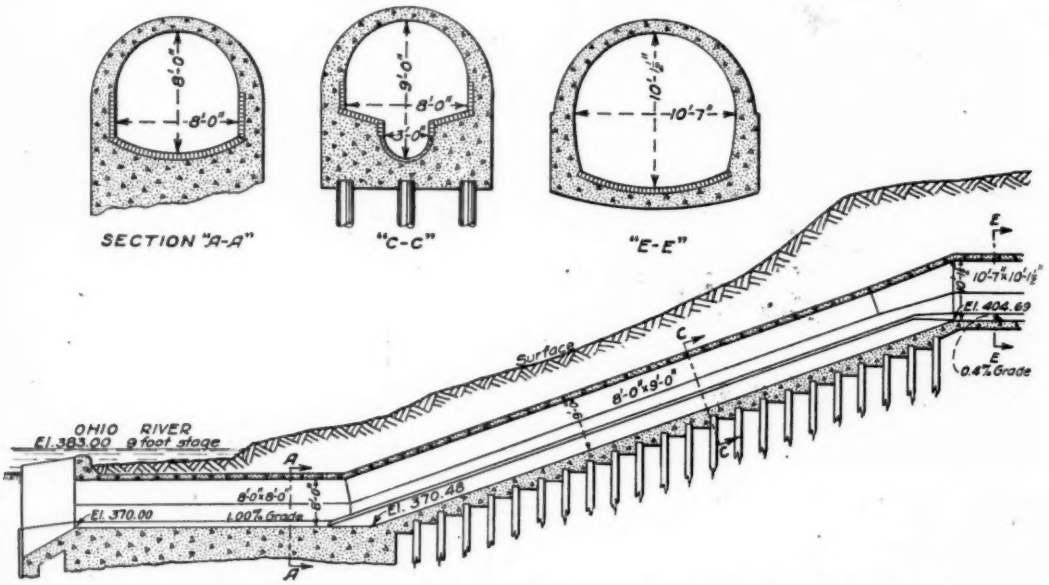


FIG. 6—OUTLET STRUCTURE, SOUTHERN OUTFALL SEWER, LOUISVILLE, KY.

WATER WORKS SECTION

WATER SUPPLY FROM GRAVEL STRATA

By John W. Toyne, Registered Engineer, South Bend, Indiana.

It is true that one of the earliest records we have of public water supply—Exodus, 17th chapter—is from rock formation, and also true that to the minds of a great many the development of a supply from rock is to be desired both from the standpoint of continuity and safety, but to the writer this is erroneous.

A great percentage of our area is ideal for the development from the gravel strata that underlies practically all of the territory traversed by the glaciers during their period and that have since been covered by a layer of soil especially adapted to the gathering of rainfall and carrying it to the gravel strata, from which it can be readily pumped.

Preliminary Studies

A careful study must be made prior to the actual development of this type of water supply, to determine the catchment area, the amount of precipitation, the percentage of evaporation and direct drainage from the area so that a rational estimate may be made of the probable supply available. Following this, tests should be made to determine the depth of the gravel strata, the character of the material and the direction and rate of flow in the vein. With these determinations made, all of the characteristics of the supply can be predicated very closely and the actual work of development can be proceeded with, or abandoned, as may be indicated by the preliminary engineering investigations outlined above.

Keep Log of Every Boring

With all due respect to the well driller, it is probable that no artisan appreciates the possibilities of his calling so little as the average well driller. The fund of valuable data that might have been accumulated from the records of drillings, had they been kept and properly classified, is almost beyond comprehension, and the unfortunate feature is that the practice of not recording the accurate log of every boring is to a great extent still current.

Having made the essential engineering investigations relative to the probable supply, a driller should be employed on the basis of his ability and equipment; an accurate log should be kept of the formations and a strainer selected suited to the material composing the water-bearing strata.

Removing Fine Sand

The writer has found in his experience that it is a mistake to attempt to screen out all of the sand, as is so often done. It is better practice, and more economical, to determine from a mechanical analysis of the water-bearing sand and gravel, the mesh strainer that will allow the free flow of the quantity desired, or possible, and then through thorough cleansing of the well in finishing it, remove the fine sand to such distance that a state of repose will continue in the strata under operating conditions with the coarser particles only next to the strainer.

Placing the Well Strainer

Two general methods are employed in placing a well strainer, and both methods have their advocates and advantages. One driving the strainer ahead of the casing, the other sinking the casing to the full depth of the finished well, then placing the strainer and pulling the casing back to expose the strainer.

To the writer, the latter method has so many advantages in its favor that he has adopted it as standard; samples of the material to be screened can be secured, accurate depths ascertained and probabilities of ruining the strainer avoided, all of which are essential.

Desirable Features in a Strainer

It should be understood that no brief is being filed for any particular type or manufacture of strainer, but a concise summary of essentials is desirable to a proper selection if maintenance is to be reduced to a minimum and continuous service secured. The first essential is, that it be of such type that a free flow of water from the vein is permitted without the probability of the finer particles clogging the openings; another feature to be avoided is, the conjunctions of different metals that may set up or facili-

tate electrolytic action. These, coupled with sturdy construction that will permit handling, should give satisfactory results.

If the above outline is followed intelligently, a satisfactory and economical water supply should be secured.

QUANTITATIVE DATA IN STREAM POLLUTION INVESTIGATIONS

By Earle B. Phelps, Consulting Sanitary Engineer, 30 Church St., New York, N. Y.

The purposes, methods and results of stream pollution investigations may be classified in two distinct groups according to the nature and uses of the stream itself. In the case of waters that are used as a source of domestic water supply, or that for any reason are to be measured and controlled by potable water standards, the primary purpose of an investigation is the determination of potability and sources of possible pollution. The methods employed are bacteriological, coupled with physical inspection of the water-shed and the results obtained are in the form of quantitative data capable of fairly exact interpretation in the light of our accumulated experience. Satisfactory progress both as to methods of study and as to the interpretation of the results is being made in this field and, while further improvement and new experience will undoubtedly be advantageous, it may be said that the situation as a whole is now upon a reasonably satisfactory quantitative basis. A single outstanding exception to this general statement is the question of the safe loading of a water purification plant and the associated question of the maximum permissible pollution of streams that are to be treated for domestic use. This field is today a sort of "no-man's land" in which there is considerable activity and over which there is much concern but thus far there is not only a lack of agreement on the major question but also lack of any authoritative view as to the proper basis for quantitative investigation.

The Investigation of Non-potable Streams

It is, however, in the investigation of the non-potable streams that the need for quantitative methods and data is most urgent and it is with this question that the present discussion has to deal. Streams which by common consent are given over to the purposes of drainage, to the exclusion of domestic water supply use, are, or should be, undercontrol in order that their various possible uses may be developed and conserved at the point of maximum utility. The purpose of an investigation of such a stream is to determine the amount, character and effect of the various kinds of drainage which it receives; the method is primarily chemical or bio-chemical, and the results should be a quantitative expression, not only of the general result but also of the distribution of the responsibility among the various sources of pollution, of the progressive effect of the pollution as it passes downstream and of the ability of the stream to return to its normal condition.

Need for New Method of Stream Examination

The chemical methods of stream examination that were generally employed a decade ago were incapable of dealing adequately with this problem. They were the methods employed in the so-called sanitary analysis of water, and before the advent and general adoption of the bacteriological methods they had a certain, although quite limited, field of usefulness in determining potability. The pollution of non-potable streams, however, by industrial and domestic wastes may lead to nuisance or stream impairment of one kind or another, depending upon the character of the waste. The determination of this effect must be based upon a knowledge of stream conditions coupled with analyses of the wastes themselves, that have direct relation to and bearing upon the kind of nuisance anticipated. The analytical scheme, therefore, cannot be a general or blanket one but must of necessity vary with the nature of the problem. Sanitary chemists have been too content in the past in resting their case upon the established schedule of sanitary water analysis regardless of the nature of the problem, and engineers, while recognizing the futility of much of this work in the practical solution of stream pollution problems, have not in general learned that better and more specific methods are readily at hand.

Since the analytical scheme as well as the entire course of the investigation varies with the nature of the waste, it will be well at the outset to classify domstic and industrial wastes according to their possible harmful effects upon the stream. For the purpose of the present general survey of the situation the following classification, though incomplete, will serve.

Classification of Domestic and Industrial Wastes

1. Wastes that in themselves are directly injurious to the stream in one or more ways. These include:

(a) Toxic substances injurious to stream life, such as acids or alkalies, copper salts, compounds containing arsenic, phenols and other poisonous organic compounds, etc.

(b) Materials capable of settling which, regardless of their other properties, may cause undesirable deposits.

(c) Dyes and coloring matter, material in a fine state of subdivision such as clay or lamp-black and oils, all of which may affect the appearance of the stream; and substances which give to the stream undesirable odors.

(d) Substances which adversely affect the chemical composition of the water with regard to industrial or other use.

2. Wastes which tend to decompose or putrify in the stream, leading indirectly to conditions of nuisance or of depreciated stream value.

Discussion of Harmful Effects

Since this classification is one of nuisances or harmful effects, rather than of industries, it will readily be seen that any given industrial waste may belong to two or more of these subdivisions. Domestic sewage for example belongs to divisions Ib, Ic and II.

In the investigation of pollution due to wastes of the first group—the directly injurious wastes—the course of procedure, although never standardized, is fairly well indicated in each particular case and the analytical results should be definite and quantitative. These results, properly interpreted in connection with data on the physical characteristics of the stream and its uses furnish a direct basis for the conclusions of the investigation.

Wastes of the second class, those which damage a stream by their decomposition are much the more common type and their study is, unfortunately, less simple. The effect of this type of pollution is neither direct nor immediate. It may be entirely absent immediately below the point of discharge and assume its maximum intensity many miles below.

The Bio-Chemical Oxygen Demand

In general the actual harm results from the partial or total depletion of the normal dissolved oxygen of the water and associated chemical changes, leading to the destruction of stream life, and general unsightly and malodorous conditions. In the methods of investigation of this type of pollution great advance has been made during recent years. It has been found in brief that the bio-chemical oxygen demand of the waste is an accurate and quantitative measure of its effect upon the stream. For example if the waste as it flows from the sewer has an oxygen demand of 200 parts per million, in 24 hours at 20 deg. C., and if the dilution of this waste in the stream be one hundred fold, then at the same temperature in the stream, two parts per million or 16.7 lbs. of oxygen per million gallons of stream flow will be abstracted from the stream during the ensuing 24 hours of flow. The demand for 48 hours or for any other period, and the effect of various temperatures, may likewise be determined. In the case of a waste which contains material capable of settling and which is discharged under conditions which favor sedimentation, the settleable and non settleable portions of the waste may be examined separately and for different periods of time corresponding to the time each remains within the area in question and the total effect of the waste will be the sum of these.

New Method of Study Substantiated

The writer has recently had occasion to utilize this method of study in a case which involved the probable cause of the destruction of fish which has occurred during several summers past. Despite the fact that the work had to be done during the winter months, it was possible to determine separately the effects, under summer conditions, of the sewage of a city, and of the wastes of certain industrial establishments and to distinguish these quite sharply from the residual effects of certain up-stream pollutions of unknown character and amount. Actual warm weather determinations of the dis solved oxygen of the stream above the sources of pollution and at a point downstream sufficiently far to have developed the maximum effect, were later available, and, despite the complications of the situation, the stream condition, as thus measured, agreed well with the results computed from the examination of the properties of the polluting wastes and the respective volumes of flow of the wastes and the river. This case is at present before the courts and may not be discussed in detail at this time but it may be said in general that a proper use of the newer methods of analytical chemistry in the field of stream pollution will furnish the necessary quantitative data for the solution of many of the complex problems that are arising with increasing frequency in the practice of sanitary engineers. The bio-chemical oxygen demand of city sewage, exclusive of industrial wastes, is now so well established that it may be applied at once

to any given population without further study. Similar standardization of the values for certain of the more standardized industries, upon the basis of output, is desirable and is being gradually attained. The employment of quantitative data will go far toward placing the subject of stream pollution and its control upon the accurate scientific basis which its importance justifies.

MISADVENTURES IN WATER SUPPLY AT SAGINAW, MICH.

(Editor's Note:—Some friend, who does not reveal his identity, has sent us a marked copy of the *Detroit Saturday Night*, for June 17, 1922, calling our attention to an article pertaining to the water supply situation at Saginaw. We have so much enjoyed reading it that it is reproduced here as a splendid example of humorous treatment of a municipal engineering problem. As originally published the article appears under the striking title, "The Gods Are Kind to Saginaw; Residents Drink Mud and Live." The subtitle is even more striking—"For the Last 16 Years This City of 61,000 Germ Imbibers Has Been Trying to Obtain a Pure Water Supply, and Though It Has Spent Much Money and Has Run the Referendum Ragged, It Is Right Where It Started, Except That a Solution Now Seems Impossible." Perhaps it is not so bad as that. Still, a city that tolerates such a situation cannot expect to escape a little good-natured joshing. Credit for the authorship of the article belongs to Alfred J. Fischer, Special Correspondent of the *Detroit Saturday Night.)*

The other day—and this is supposed to be a true story—a traffic officer in Flint arrested an autoist and haled him into court.

"You are charged with running past a standing street car," said the judge sternly, "and at the station they found a case of beer in your automobile. You don't look like a vicious citizen or a bootlegger, yet you endangered the lives of passengers and broke the law regarding liquors. What have you to say for yourself? Where do you come from, anyhow?"

"Saginaw," murmured the humble flivverist.

The judge looked at the meek culprit compassionaely. Then he turned to the prosecutor.

"I don't think we ought to press this case. Why, this poor man comes from Saginaw. The people there have not seen a street car for months, and if I lived in a burg where everybody had to drink mud highballs, I think I would take a chance on smuggling in a cold bottle myself. Case dismissed. Go home and keep away from a regular city."

That was the first bit of anecdote and comment given the writer when he dropped into Saginaw a few days ago to investigate why Michigan's fourth city, with a population of 61,000 germ drinkers, is still pumping mud into its mains after 16 years of agitation for pure water. Since 1906 there have been nine referendums on a total of 13 questions dealing with pure water supply. During this time hundreds of houses were built and every time one was constructed, a little hand pump was installed back of the kitchen door, as is still done in Lima Center and Hatch's Crossing (you'll find them both in the gazeteer).

Saginaw gets its water from the Saginaw River. The stream has played the town other mean tricks besides acting as its namesake. You know how rivers take on personality and become famous for their color or characteristics. There is the Blue Danube, for instance, and muddy Maumee. Well, the Saginaw River would defy the efforts of phrase-makers and alliterationists if its color were to be linked with its name, for it is a sort of henna shade most of the time. Still, it might be called the Solid Saginaw, because those who know say that it supplies both food and drink to its consumers.

The agitation for pure water in Saginaw began in the early part of the twentieth century, anno domini. There was then a population approaching 50,000 and it became apparent that something should be done. The records show that for $400,000 a filtration plant and pumping station could have been constructed. When the matter was put to a vote at a referendum in April of 1906, it was defeated almost three to one.

That was the beginning of a series of elections that must have made the inventor of the referendum not merely turn over in his grave—if he is dead—but spin around in it. They voted money for engineers to determine where an adequate water supply could be obtained. They voted to have other engineers check up the first batch. They decided to get water from Saginaw Bay, which like Winchester, was 20 miles distant. They had all the plans prepared by the best engi-

neers in America, right of way partly bought and partly optioned; pumping station sites procured at either end, mains extended in the city to receive the A. Pura, and then, as we say in the movie sub-titles—

They decided the Bay water project wouldn't do, that the real simon pure stuff was in the Shiawassee River, and they voted the whole business down. They started over. They referended some more. They have spent enough money on elections and electioneering in the past 16 years to build a pumping station and have enough money left for machinery and a barbecue on the day it would be started up.

From this point on, it will be necessary to mix metaphors for Shiawassee water,riding into fame as a political football, began to have hard sledding. Some of its friends did not like the ideas of Saginaw Bay adherents on street railway matters and other local issues, so that it did not take long for two factions to form —each number considering themselves irreconcilables. The industrial element for the most part favored the bay plan, because the water was softer and would be easier on boilers. Bay water would cost more at the outset to obtain, but once the initial plant was constructed, there would be no expense of softening. The Shiawassee River folks emphasized the economy of installation, since much of the way between the source and the city pumping station could be by an open canal, easy and economical to construct.

Both sides have been mortally offended by the tactics of the opposition, so that the antis to any given scheme, whatever it may be, plus those who have installed elaborate filters in their homes, added to the large volume of voters who are opposed to public improvements because they do not like the mayor or the city assessor, plus the friends of a cause who stay away from the polls entirely, are always numerous enough to defeat whatever proposed solution goes on the ballot.

In 1910, after four years of agitation since the first effort to settle the matter, the same plan went before the people again, and this time it lost by only 342 votes of the required three-fifths majority, with about 7,000 votes cast. From then on, at every election except one, the water referendums carried by straight pluralities but never received the required three-fifths, until the last time, in April of this year, when a referendum to raise the city's bonding limit and another to bond for $2,800,000 to provide Shiawassee water went down to stinging defeat.

There was one exception to this dreary record, and that was early in 1920, just before the slump in business. Saginaw was like a little teapot, bubbling over with optimism. The General Motors Corporation had constructed several large units, adding millions in property values to the city; houses were going up all over town, bank clearances were reaching new heights, and everything was just grand. Allen Hazen, one of the foremost engineers on water supply in the United States, had come out from New York and laid down a program based on months of careful research. He had been checked up by Gardner S. Williams, of Ann Arbor, another consulting engineer with much national experience. It was decided that for a town growing as rapidly as was Saginaw, with the prospect of some day annexing many of its suburbs, such as Flint, Bay City and Highland Park, nothing would be too good.

Accordingly, on February 24, 1920, there was an election at which everything carried. By a margin of 2,005 votes above the required three-fifths, out of a total of 7,800 ballots cast, it was decided to appropriate $500,000 to start work, buy land and make extensions to mains. A majority of 2,780 voters decided in favor of the Saginaw Bay project as against the Shiawassee. The problem was solved. The half million was almost entirely spent for right of way, additions to the city distribution system, station sites, and $81,000 went for a complete set of plans needed by the contractors. The 1921 legislature, at one of its flock of special sessions, took time out from quarreling about the rate of interest to be paid on bonus bonds, to permit the City of Saginaw to increase its bonding limit sufficiently to cover the cost of the improvement. Visitors were told with pride how the matter was settled after 15 years of bickering.

But alas, for the deluded mortals who took that much for granted. The program voted was a prosperity issue. With the passing of the silk shirt days disappeared also the enthusiasm for the $5,000,000 program. Hadn't they gotten along this far with river water, deep wells on every street corner, and hand pumps? Hadn't there been wonderful progress made in house filters? Hadn't the courts enjoined some of the big corporations inland from polluting the streams quite so much? What was this conspiracy on the part of the big business interests to load

taxes on the people, burdens to be carried by generations yet unborn! Were the city fathers competent to supervise this tremendous effort? Weren't the folk who wanted to pipe the bay water to Saginaw at a cost of millions the same people who wanted to sell the city out to the street railway? Abas! Selah! Thumbs down!

Now there had arisen during the good times when things went so well a citizens' water committee headed by Arnold Boutell, a manufacturer and highly esteemed civic leader. He had won the only victory ever achieved by combining all the forces, civic, fraternal, mercantile, professional, in the interests of a solution. When he saw the tide turning and politicians riding into power by opposing the program which had once been voted by such a splendid majority, he decided that in order to silence the opposition and retain unity, there ought to be another referendum. The Shiawassee project had gained many friends. They were entitled to another defeat and his committee wanted a vote of confidence. Therefore another election was held on December 7, 1921.

There were two questions. The voters were to decide again whether they wanted Bay water or Shiawassee water. They were also to cast 60 per cent of their ballots for sufficient bonds to carry either program. If Bay water carried and bonds received the needed majority, then $4,300,000 would be raised, the cost having come down slightly since the proposition was first submitted. If Shiawassee water won and enough votes were cast to allow issuing bonds, then the total was to be only $2,800,000. When the official figures were in, the bonds lacked the needed percentage by 888 votes, although they had received a plurality of 414 votes. Also, the Shiawassee plan was carried by a vote of 4,830 against 4,554.

It was a bitter pill. All the work that had been done, all the money spent for plans on the bay project, was wasted, and lines of discussion and opposition were more sharply drawn than ever. The Bay project blue prints can be bought for old paper.

The curtain rises again. There has been a lapse of five months since the last act. The street corner pumps have served as well-reared pumps should. The business slump has had its deadening effect. The corner has been turned. Normalcy is assured. The Saginaw River continues to give up its liquids and solids.

The water problem had been filed in the archives for a time since there had been other things to quarrel about. Into the limelight had come the street railway issue. A ten-cent fare had been inadequate to meet expenses of operation against jitney bus competition, and the company wanted relief to keep out of a receivership. None was forthcoming, so the cars went into the barns and the company went into bankruptcy court. That was in August, 1921. The jitney men promised to meet the transportation needs. Glib salesmen for motor bus builders tried to float companies, so they could sell them vehicles. It was a great season for the smokeshop experts while it lasted.

In the middle of it someone started in again to settle the water question. Shiawassee water had won in the last engagement and should be voted upon exclusively. A bond issue of $2,800,000 was submitted again, together with a clause permitting the city to amend its charter in accordance with the legislative enactment increasing the bonding limit. Both went down to disastrous defeat. The water bonds lost by 1,085 votes and the charter clause by 970 of the necessary three-fifths. In each instance the simple plurality was not received.

The writer was taken over the city to visit the pumping stations of which there are three. At the sight of the first he was reminded of a production of "The Flying Dutchman" staged some years ago by David Warfield. He was again viewing the deck of the phantom ship and hearing the old men of the crew moaning down in the hold, begging their captain to atone for his sins, so that they could die and have rest. For half a century the pumps have creaked their way through time, serving bisque to young and old, rich and poor. Season after season the water has come to them from the sources of the Tittabawassee, Cass, Flint rivers and other streams, flowing past the sugar beet and chemical plants, and moving on friendlessly until the pumps sent it throughout the city. Kind-hearted fire underwriters have condemned the boilers which serve as taskmasters, but the city will not replace even these, since it is hoped that some broader plan may be adopted any day which would cause replacement cost to be wasted when the stations were scrapped.

There are two such stations, one on

either side of the river. The third one is a dapper little spot where two trim, modern electric pumps help out with about 4,500 gallons a minute and increase pressure throughout the congested sections of the town. That the venerable pumps consume far greater quantities of coal than modern ones, that constant breaks make it necessary to fabricate new sections in an eastern foundry cannot be helped.

Lack of leadership is given as the cause by those who pretend to know. The controversy has created thousands of what is known as "curbstone engineers," each of whom has a solution and will not budge in the interest of a settlement. It does not make it any easier that the city recently amended its charter and installed a commission form of government as an efficiency measure. This plan provides for election of councilmen at large and the winners are placed at the heads of various city departments. The city engineer, a technical man, must look to his fences, and whatever he plans or inaugurates may be upset if his opponent, possibly an ex-bartender, should be able to poll a few more votes.

There is also much feeling over the law which requires a 60 per cent majority to amend a charter or vote bond money. Those who have studied the situation in Saginaw state that there are always 20 per cent who oppose anything progressive, making it necessary to recruit the winning votes from those who are left. In March, 1915, a referendum for $675,000 for a consolidated pumping station, filtration and softening system lost by only 58 votes of the needed majority. That number of Saginaw citizens who were known to be favorable to the proposition were in California at the time, and if the absent voters' law could have been invoked then in the interest of the improvement, things might have been different.

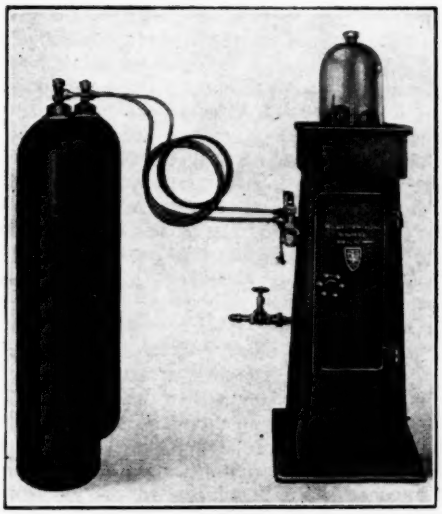
Nobody pretends to know what the next step will be. Everybody has been vindicated and everybody has been defeated. One city official was asked what the history of Saginaw's water problem might have been if the matter had been left to private enterprise, and he looked so dangerous that the interviewer did not pursue this line of discussion.

The last word on the subject was by an editorial writer on the Saginaw News Courier who advised his readers not to weaken.

THE "W. & T." VACUUM FEED CHLORINATOR

The "W & T" Vacuum Feed Chlorinator is a self-contained unit, exceedingly simple to install and operate. It is built with the pedestal type of mounting, and with the chlorine pressure reducing and constant rate of control mechanism housed under a glass bell jar in a rubber tray container at the top of the pedestal. The chlorinator is illustrated herewith.

To install the equipment it is necessary only to set at a suitable location on the floor of the pumping station, connect up a water supply line to the gate valve at the lower left hand side of the pedestal, connect the cylinder of chlorine to the chlorine gas valve at the upper left hand



THE W & T VACUUM FEED CHLORINATOR

side of the pedestal, and connect the solution discharge line, which is shown projecting out to the right at the base of the pedestal, to the desired point of application in an open well or into a main.

The chlorine gas comes in through the chlorine manifold valve above referred to and the pressure of this gas is indicated on a gauge just behind this valve on the manifold. From the manifold the gas passes up through a silver tube to a ball float type of reducing valve housed under bell jar.

Located in the base of the tray at the center part is an injector for making a solution of chlorine and water. The water supply is admitted through the gate valve at the lower left hand side of the pedestal, passes in through a water strain-

er where the pressure is indicated by means of a gauge at the top of the strainer housing, then passes through a water pressure reducing valve and up to the injector. A gauge is provided on the discharge side of the pressure reducing valve to indicate at all times the reduced pressure which is the operating pressure of water at the injector throat. The vacuum produced by the flow of water through the injector produces a vacuum in the bell jar, this vacuum being transmitted to the bell jar through the meter tube assembly. The only communicating ports between the meter tube assembly and the inside of the bell jar are small ports below the water level in the jar, and the calibrated orifice at the top of the meter tube. Projecting up in the center of the glass meter tube is a silver tube, the height of which is adjustable by means of the rack shown at the middle right end of the pedestal. The suction port from the injector throat communicates directly with the interior of the glass meter tube through the inner silver tube and produces a vacuum in this tube which must be satisfied either by water which is carried up through the communicating ports at the bottom of the glass meter tube, or by gas which is admitted through the calibrated orifice at the top. It will thus be seen that the differential head on the calibrated orifice may be directly controlled by the height of the inner silver tube inasmuch as when a suction is produced on this inner silver tube, the water will be carried up into the glass meter tube to a point where it is sucked over into the inner silver tube above. The height of water inside of the bell jar will be the differential head across the calibrated orifice.

Inasmuch as the injector is pulling a vacuum on the meter tube, and this must be satisfied from the interior of the bell jar, a partial vacuum will be produced inside of the bell jar which in turn will tend to raise the water level inside the bell jar and will so raise the ball float which controls the gas inlet valve to the tray. This will permit the chlorine gas to pass into the bell jar, from there through the calibrated orifice into the meter tube and to the injector throat, where it will be absorbed by the water passing through the injector, and the resulting solution of chlorine and water will be lead away through the solution discharge hose to the desired point of application. It is obvious that if gas is admitted to the bell jar more rapidly than it is taken out through the meter tube, the partial vacuum in the bell jar will be decreased, the water level inside of the bell jar will fall slightly, and cause the ball float mechanism to drop, so throttling down the supply of chlorine to the bell jar until a condition of equilibrium is reached.

Conversely, if the supply of gas to the bell jar is not sufficient to satisfy the demands of the injector through the meter tube, the partial vacuum inside of the bell jar will be increased causing the water level inside of the bell jar to rise and open further the chlorine inlet port, so admitting chlorine gas to the bell jar at a greater rate until the demand is satisfied. It will be seen that this arrangement forms a constant flow device which will give a uniform flow of chlorine through the apparatus for any setting of the adjustable silver tube inside of the glass orifice meter tube. The equipment is so designed that the variations in height of the silver tube may be controlled at any desired height of from zero to 8¼ ins., and the glass orifice meter is therefore designed in each equipment to give the maximum rate of flow for that particular capacity of apparatus, with the maximum height of the silver tube inside of the meter tube, i. e., about 8¼ ins., and this height will be the maximum differential which may be obtained through the orifice.

There is a small float valve mechanism which admits the necessary water to the tray to make up for that which is being constantly drawn in through the meter assembly.

Inside the bell jar in addition to the ball float reducing valve and meter tube, there is provided a ball float vacuum relief valve which admits air to the jar if the water supply to the injector is turned on without the chlorine supply to the apparatus being turned on. This prevents excessive vacuum being produced in the bell jar which would raise the water to such a level that it would get back into the gas inlet connection. It further functions to allow any leakage through the chlorine float reducing valve to escape to the outside atmosphere instead of being discharged into the room in case the equipment is left for any length of time with the water supply shut off but with the chlorine turned on.

The Vacuum Feed Chlorinator presents many new features in the control and application of chlorine which appeal to the water works operator. It is rugged in appearance, all parts are very easily accessible and the entire equipment can be disassembled for cleaning and reas-

sembled even by a novice in less than an hour's time. All operating parts are visible—there are no bolts to remove to enable one to get at the reducing valve mechanism. It is simply necessary to shut off the gas, allow the water supply to continue to run for a few moments, then lift the bell jar out of the tray and all the elements of the reducing valve control mechanism are exposed for cleaning. The water supply line is equipped with a large area strainer of special design which minimizes the frequency with which the screen must be removed for cleaning. The water pressure reducing valve is also of special design having been particularly developed for use with this type of equipment to give the minimum loss of head through the valve and yet hold the reduced pressure constant at all times regardless of the inlet pressure applied.

Inasmuch as the equipment always operates under a partial vacuum, it can be operated with lower chlorine pressure in the containers than any other type of chlorine control equipment, and will function perfectly with chlorine pressures as low as 25 to 30 lbs. per sq. in., which represents the pressure of chlorine at about 15 deg. Fahrenheit. This means also that it is more easy to get all the chlorine out of the chlorine cylinders.

Repair charges are also reduced to a minimum inasmuch as there is absolutely no possibility of getting moisture back into the gas line with the resultant corrosive action.

The most notable feature with respect to this type of equipment is that when the water supply to the apparatus is shut off, the flow of chlorine is automatically shut off by means of the ball float reducing valve and consequently there is no possibility of chlorine gas escaping into the pumping station because of failure of the water supply to the apparatus.

SMALL INDUSTRIAL SEWAGE TREATMENT PLANT

By George L. Robinson, Consulting Engineer, 5621 Grand Central Terminal, New York, N. Y.

The Haberland Manufacturing Company, located near Paterson, N. J., will employ a maximum of 420 persons. It is estimated that the domestic sewage production will not be over 50 gals. per person per day. The nature of the sewage will be purely domestic. There are no laundries or kitchens, and there will be no trade wastes discharging into the sewer.

It is proposed to take the sewage from the building through a 6-in. sewer to the treatment plant. This plant consists of the following elements: Gate Chamber, Settling Tanks and Chloride of Lime Sterilizing Outfit.

Gate Chamber

This is a concrete structure, semi-circular in form, provided with two stop planks, or gates, set in the invert of the sewer, which will be moulded in the concrete floor. These gates are to be of wood provided with steel strap handles painted with creosote paint. They fit in a slot moulded in the concrete at right angles to the invert. A wrought iron or steel door, lifting with hinges or otherwise, is to be provided in the roof for easy access to the gates.

Settling Tanks

The flow of sewage water from the factory may be deflected into either or both units of the settling tanks. When the total population is in the factory, each unit, consisting of the tanks, is to be worked for six months at a time, the organic matter standing in the one unit and digesting for six months, at the end of which time it can be removed by a hand pump through the covers of the roof.

The sewage will enter each tank from the gate chamber by means of a 6-in. vitrified or cast iron soil pipe Tee.

Each tank will be 9 ft. long and 6 ft. wide, having a maximum depth of 8 ft. The baffle wall will extend across each tank 1 ft. from the overflow end. The dividing wall will be beveled in the form of a weir.

The entire structure is to be built of concrete. The floor is to be 6 ins. thick and walls to be 8 ins. thick. The floor is to be reinforced by approved wire mesh or other metal. The walls and roof are to be reinforced by ½ in. steel deformed rods set at intervals of 18 ins. staggered in the vertical direction and 2 ft. horizontally on centres.

If the contractors prefer to bring the baffle walls up to the underside of the roof, they may do so, making due allowance for the manhole openings at the outlet end. Manhole openings in the roof will be provided.

Sterilizing Outfit.

The sterilizing outfit will consist of a concrete tank. This tank is divided into two parts, each 4 ft. long and 3 ft. wide. The walls are to be 4 ins. thick, made of concrete mixed with waterproofing.

Only one-fifth of the buildings owned by the Bell System are shown in this picture.

A Telephone City

Above is an imaginary city, made by grouping together *one-fifth* of the buildings owned by the Bell System, and used in telephone service. Picture to yourself a city *five times* as great and you will have an idea of the amount of real estate owned by the Bell System throughout the country.

If all these buildings were grouped together, they would make a business community with 400 more buildings than the total number of office buildings in New York City, as classified by the Department of Taxes and Assessments.

Next to its investment in modern telephone equipment, the largest investment of the Bell System is in its 1,600 modern buildings, with a value of $144,000,000. Ranging in size from twenty-seven stories down to one-story, they are used principally as executive offices, central offices, storehouses and garages. The modern construction of most of the buildings is indicated by the fact that the investment in buildings is now over three times what it was ten years ago.

Every building owned by the Bell System must be so constructed and so situated as to serve with efficiency the telephone public in each locality, and to be a sound investment for future requirements.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service

The structure will rest on concrete piers 12x12 ins. at an elevation of 3 ft. above the finished floor. In the upper part of each storage tank will be a mixing trough 12x12 ins. inside dimensions, each trough to be 4 ft. long. A 2-in. hole will be provided in each trough, each fitted with a wooden plug, brass ring and chain. In front of this structure will be a small wooden platform.

From the bottom of each storage tank will extend a brass pipe to an automatic dosing box. This 2-in. brass pipe will have two valves.

On the floor in front of the storage tank and directly over the brick well will be set an automatic dosing orifice box such as is manufactured by the Roberts Filter Manufacturing Company of Darby, Pennsylvania, or equal.

A 1-in. water pipe will be provided to the mixing trough and a piece of hose about 2 ft. long provides so that water may be distributed into either of the mixing troughs.

This entire structure will rest on a concrete floor and should be enclosed in a neat wooden house of suitable dimensions.

The overflow from the settling tank will pass through a 6-in. vitrified pipe and make connection with the mixing chamber.

ENGINEERING IN THE SMALL MUNICIPALITY

By E. G. Orbert, Consulting Engineer, 627 M. & M. Bank Bldg., Milwaukee, Wis.

The small municipality frequently presents problems which are, in a way, more difficult of solution than those of the larger cities. This is usually due to the engineering (or rather lack of engineering) which has been practiced in such towns in the past.

It was formerly the custom to call in some local or county surveyor to lay out any improvement of whatever nature, or in the case of sidewalks the contour of the ground was too frequently taken as the established grade as "fitting the property" best. Now the old-time county surveyor may have been an excellent man *as a surveyor;* he may have been able to establish the property lines much better than an outside man could have done, but his lack of experience in other problems in all probability led to mistakes which are almost impossible to correct at the present time. Sewers were built too small, or by piecemeal without any comprehensive plan for future extensions; street grades were practically fixed by permanent structures, such as sidewalks, buildings, etc., without much apparent attention to drainage.

One of the worst and most frequent obstacles to overcome, already referred to, is the disregard to the future in laying concrete sidewalks. The writer has time and again encountered cases where the sidewalk on one side of a street was 3 or 4 ft. higher than on the other, or where there was a dip in the middle of a block which, when paving the street, necessitated several hundred feet of storm sewer which could have been eliminated in most cases by the establishing of a proper grade in the beginning.

The extra expense involved in correcting these early errors and in fitting the conditions as they are found, so as to cause the least damage to property, almost invariably costs the municipality several times what a competent engineer would have charged for establishing the street grades, or for drawing a sewerage system plan.

The great difficulty has been in the past, in educating the public to a realization of the necessity for this preliminary work. The average village official is under-paid, or not paid at all, and cannot be expected to devote much of his time to the study of municipal economics. However, the influence of state organizations, such as boards of health and highway departments, is gradually being felt, and it is becoming more frequent for the consulting engineer to be called in either to take charge of a proposed improvement, or as consultant to the local engineer, or surveyor, and it is to be hoped that local authorities will come to realize that it is no more a reflection on his ability or intelligence to do so, than it is for the local physician to call in a specialist for consultation on an important or especially difficult case.

STATE DEPARTMENT USES RADIO

State Highway Commissioner Frank Page of North Carolina, will have installed in his office in Raleigh a radio broadcasting station and receiving stations in each of the nine district offices located at Tarboro, Kinston, Wilmington, Durham, Greensboro, Charlotte, Elkin, Marion and Asheville. With this equipment the administrative forces of the Commission will be able to get in immediate touch with the construction and maintenance engineers throughout the State and thus effect a saving of several hundred dollars per month in telegraph tolls and in stenographers services.

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In cast iron rust never penetrates below the surface; the first layer of oxide which it forms acts as a protection, effectively preventing further corrosion. Should the tar coating placed on all water pipe become destroyed, the metal will, in this way, form its own coating.

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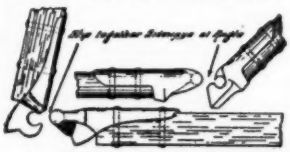

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Construction News and Equipment

SUCCESSFUL USE OF CORE DRILL ON INDIANA STATE ROADS

A few months ago the Indiana state highway commission purchased a machine for drilling cores out of hard surface pavements. It cost $1,200 and its acquisition is to determine if contractors lay concrete pavement according to specifications, especially as to the designated thickness of slab.

The first test was made in Lake county on a section of the Lincoln highway, and 1,200 ft. of pavement rejected as not up to specifications. The contractor decided to give the inferior pavement to the state rather than tear it up and rebuild it, so approximately $6,000 was deducted from his contract price in final settlement.

Lately by the purchase of equipment costing $250 the core driller can be used for bridge foundation exploration. The driller cuts a core four inches in diameter out of solid rock, and when this core is tested in the commission's laboratory, engineers seeking to locate a solid foundation beneath the earth's surface and frequently far below a river bed, know positively what strength the foundation will be which is to support the bridge crossing.

This machine has paid for itself many times in the short time it has been in use in Indiana, and it is one of the best investments the Indiana state road body ever made, says a recent press release of the commission. Indiana is one of the early states to adopt the core tester, and its advent into state road work was opposed by some people on the ground it was unfair to contractors. The commission takes the position that Hoosier roads and bridges must be according to specifications, and its use is with fairness to the taxpayers.

The first place where the tester, after being equipped for bridge foundation exploration, was used, was in Orange county near French Lick where the highway body is building a concrete bridge across the famous "Lost River." Here the tester took out cores from solid rock 23 ft. below the surface of the water.

Approximately six miles of finished concrete pavement laid this summer in three contract projects on the east end of the National road meet specifications of the state highway commission in every respect according to tests made by cores drilled in the pavement and subjected to laboratory analysis, John D. Williams, Indiana highway director, announces.

Cores removed from finished pavements by the driller are subjected to laboratory tests which removes any doubt as to the quality of pavement laid. Regardless of how smooth and pleasing to the eye a finished pavement may appear, there is always a chance that through error the slab is not laid to designated thickness. A test by the machine proves conclusively if the pavement is up to standard. This machine, highway officials say, will go further than any other equipment invented so far to prove to the public that state roads are built to plans and specifications.

A LARGER SIZE P. & H. CORDUROY EXCAVATOR CRANE

In 1920 the Pawling and Harnischfeger Co. built for the U. S. Reclamation Service a machine designed to have as large capacity as possible and at the same time designed so that it could be loaded upon a standard flat car without the machine proper being dismantled.

The demand for a larger size excavator designed to come within standard railway clearances without dismantling, has greatly increased and for this reason the P & H 208 machine is now being placed on the market as a part of the Standard P & H Line.

This machine will handle a 1-yard Page dragline bucket on a 35-ft. boom, a ¾ yd. Page bucket on a 40 ft. boom or a ½ yd. bucket on a 50 ft. boom. It will also handle clamshell buckets of from ½ to 1½ yds. capacity depending upon the material handled. With but a few unimportant changes the 208 can be converted into a powerful gas shovel handling a 1-yd. dipper. In addition to being used as a gas shovel or with clamshell and dragline buckets, the 208 machine can be used with backfilling scraper, crane hook or electric magnet.

The 208 is of rugged steel construction, of the full revolving type, and is one-man operated. Turned shafts, of forged alloy steel where necessary, are used. All gears are of steel with cut teeth. The corduroy tractions are of the P & H self-cleaning type having special high carbon cast steel treads and heat-treated alloy steel link pins. The corduroys are completely available for inspection and renewals with a minimum of jacking. The ground bearing pressure is about 10 lbs. per square inch.

By means of independent gear drives on each corduroy the following motions may be accomplished.

1. A high speed forward and reverse on both corduroys.
2. A low speed forward and reverse on both corduroys.
3. A high speed forward and reverse on one corduroy and a low speed forward and reverse on the other interchangeably.
4. A high or low speed forward and reverse on one corduroy with other corduroy running idle, interchangeably. All of these motions are controlled from the operator's platform regardless of the position of the revolving frame. The transmission gears move on spline shafts. The construction effectively prevents the gears from sticking.

A 7¼x9 75 H. P. heavy duty internal combustion motor running at 500 r. p. m. is gear connected to the jack shaft, the connecting gears running in an oil tight cast iron case. Outside band clutches of liberal design are used for connecting the engine to the jack shaft, and for the combined swinging and propelling shaft. Drums are mounted on separate shafts, the digging drum being provided with machine cut grooves.

The boom is hoisted and lowered by means of a drum operated by self-locking worm and worm gear enclosed and running in oil.

Operating levers are concentrated at the right front side of the machine giving the operator full view of the work. The machine is completely enclosed by a sheet steel housing.

VALUABLE TRADE LITERATURE

(Editor's Note—Copies of the trade publications here briefly reviewed may be obtained by writing to Municipal and County Engineering, or by writing direct to the addresses given in the reviews.)

Power Scrapers and Dragline Cableway Excavators.—Sauerman Power Scrapers and Sauerman Dragline Cableway Excavators are illustrated and described in pamphlets Nos. 16 and 17, respectively, recently issued by Sauerman Bros., 1142 Monadnock Block, Chicago, Ill. The range of adaptability of the line of bottomless power scrapers is clearly indicated with numerous illustrated examples. Some of the more important applications are: loading direct to cars and trucks through a trap; small gravel pit operations; large sand and gravel plant operations; removing overburden, making cuts and fills; and stock-piling and reclaiming loose materials. The treatment of the dragline cableway excavators is with special reference to the handling of sand and gravel in both large and small operations.

Activated Sludge Process of Sewage Treatment.—Illustrated descriptions of the activated sludge plants at Woodstock, Ontario, and Gastonia, North Carolina, have been published in a pamphlet by the General Filtration Co., Inc., Rochester, N. Y. Incidentally, it is interesting to note that such large cities as Chicago, Milwaukee, and Indianapolis, and such small cities as Mamaroneck, N. Y., and Graham, Texas, are now installing activated sludge plants.

Velocity Stage Turbines.—A line of velocity stage turbines especially designed for high pressure and high temperature steam is described in a 28-page catalog issued by the De Laval Steam Turbine Co., of Trenton, N. J. The cast steel steam chest is located in the casing cover in order to avoid the conduction of heat to the bearings. In addition to the speed governor and governor valve, there is an independent valve controlled by an automatic overspeed trip. The turbines are built in sizes up to 1,200 H. P., and are designed to be directly coupled to high speed centrifugal pumps and blowers, AC and DC generators, and by means of double helical speed reducing gears, to large pumps and blowers, medium size generators, belt pulleys, rope sheaves and slow and moderate speed machinery.

New Road Oiling Equipment.—A new road oiling machine, known as the Champion Pressure Heating Distributor for mounting on motor trucks, is illustrated and described in bulletin K. E. S., recently issued by the Good Roads Machinery Co., Inc., Kennett Square, Pa. This equipment is for use in applying road oils, tar products and dust-laying materials. This machine has been designed and perfected by engineers who have a practical knowledge of the proper application of bitum-

inous binders in quantities. It has been well tried out and has been uniformly successful.

Contractors' Type Scoop Conveyor.—Five thousand Scoop Conveyors have been sold in five years, designed primarily for handling coal. Realizing that upkeep costs, when handling such sharp and abrasive materials as crushed stone, sand and gravel, in a machine designed for handling coal, The Portable Machinery Co., Inc., Passaic, N. J., has perfected, and issued an illustrated bulletin on a contractors' type scoop conveyor. The bulletin shows the various applications of this new scoop conveyor on road and other construction work and gives its performance records. Extracts from users' letters are quoted.

Duplex Pumps.—A 68-page catalog (No. 107) on "Durable" Duplex Pumps for all purposes issued by Dean Bros. Steam Pump Works, Indianapolis, Ind.

Concrete Mixers.—"Smith Snapshots," Vol. 11, No. 1, the house organ of the T. L. Smith Co. of Milwaukee, is being distributed. It contains information and illustrated articles on Smith Pavers, Smith Tilting Mixers used in central mixing systems, and on water works construction, Smith 7-S and 4-S Mixers, and the Smith Excavator and Loader.

Ratchet Pipe Cutters.—A pamphlet on the money-saving possibilities of the Strickler line of ratchet pipe cutters, issued by W. W. Strickler & Bros. 380 Hamilton Ave., Columbus, Ohio. Eight sizes of cutters for cutting any size of cast iron, steel or wrought pipe by hand, are illustrated.

Excavating Equipment.—Bulletin 57-X just published by the Pawling & Harnischfeger Co., of Milwaukee, describes and illustrates in its 36-pages P & H Gas Driven "8 in 1" Excavators of various sizes and types including full circle swing gas shovels, draglines, grab bucket cranes, material handling cranes, and the other rigs to be used with this machine, as the skimmer scoop and pile-driving rig, and such accessories as may be used with these cranes as the backfilling scraper bucket, hook and sling chains, and electro magnet. This Bulletin supersedes No. 56-X with additional information on the 208 and 210 Excavators. These larger machines are also mounted on the P & H Corduroy Traction which has given rise to the slogan, "Follow the Corduroy Trail—the Tread Mark of P & H Equipment."

Paving Mixers.—"Smith Pavers" is the title of a new 32-page catalog recently published by The T. L. Smith Co., of Milwaukee. This catalog contains many illustrations and the latest information on Smith Paving Mixers, which are built in sizes 10-E, 14-E and 21-E. Among the new developments mentioned are the full caterpillar type traction machines, which are being manufactured in the two larger sizes. These sizes may still be equipped with half caterpillar traction, when desired, while the 10-E size, used largely on street and alley work, is provided with wheel traction as formerly. The particular features of the new Smith full caterpillar traction unit which are of interest to contractors are described in detail. Another Smith feature that is brought out in the catalog is the small number of operating controls. These, in conjunction with the automatic operations, so it is claimed, make one-man operation a practical reality.

Scoop Truck Bodies.—The Eastern Scoop Body for Ford Trucks is described and illustrated in Bulletin 32 issued by the Easton Car and Construction Co., 50 Church St., New York, N. Y.

Hydrogen-Ion Outfit.—The La Motte Hydrogen-Ion Comparator Set is described in a pamphlet issued by the La Motte Chemical Products Co., 13 W. Saratoga St., Baltimore, Md.

Road Graders.—A folder on the use of Adams Adjustable Leaning Wheel Graders, and which explains the leaning wheel principle involved, was issued recently by J. D. Adams & Co., Indianapolis, Ind. It is claimed that the adjustable leaning wheel feature, which is an exclusive feature on Adams Graders, enables the operator to hold the machine wherever he wants to work it and to move a capacity load without skidding, or waste of power.

Compressed Air Tools.—A few suggestions on the use of compressed air tools, with a general idea of the saving possible as compared with hand methods, are given in a folder issued by The Ingersoll Rand Co., 11 Broadway, New York, N. Y. The development of the Portable Compressor has made it possible to secure compressed air when and where it is wanted. The folder refers especially to small or "short time" jobs.

Integral Waterproofing.—The Science and Practice of Integral Waterproofing is the title of a 32-page booklet issued by the Truscon Laboratories of Detroit, Mich. It describes the process as applied to basements, cement, stucco, reservoirs, cisterns, tunnels, standpipes, foundations, subways and masonry structures of all kinds.

Steel Forms.—The most complete catalog on steel forms for use in street and highway construction ever issued is catalog No. 28 recently issued by the Heltzel Steel Form and Iron Co., of Warren, O. In addition to featuring steel forms, this 24-page catalog illustrates the Universal Tamping and Finishing Machine and describes a new method of building culverts by the use of the same steel road forms used on general road construction.

Asphalt Booklets.—Simple, comprehensive, well-illustrated booklets on the different types of asphalt pavement construction including Sheet Asphalt, Asphaltic Concrete, Asphalt Macadam, Asphalt Filler, Asphalt to Resurface Worn Brick, and Asphaltic Road Oil, have been prepared by The Texas Company, Asphalt Sales Department. "What is Your Highway Problem?" is the name of a portfolio issued by this company which gives a brief resume of the facts of each highway construction use to which asphalt is put. Anyone desiring any of the above booklets may very readily procure them by addressing a brief request to The Texas Company, Asphalt Sales Department, 17 Battery Place, New York City.

Powdered Fuel Equipment.—This is the first general catalog pertaining to Grindle Powdered Fuel Equipment. It contains 40 pages of text and illustrations. It makes plain the advantages of powdered fuel in general and also the special advantages of the Grindle System. This catalog will be supplemented by bulletins from time to time describing the application of Grindle equipment to various classes of work. A copy of the catalog may be obtained from the Grindle Fuel Equipment Co., Harvey, Ill.

Drinking Fountains.—A folder on drinking fountains for public streets, parks, playgrounds and school yards, issued by The Murdock Mfg. and Supply Co., Cincinnati, Ohio. Pertains to the Murdock anti-freezing bubble font which is especially designed for outdoor installation.

Oil Burning Appliances.—Bulletin No. 20, issued by Aeroil Burner Co., Inc., 266 Hudson Ave., Union Hill, N. J., illustrates and describes appliances for roofers, waterproofers, paving contractors, insulating contractors, railroads, roadbuilders and street and highway departments.

Architects Specification Handbook.—An 8½x11 in., 108 pages, loose leaf handbook issued by The Truscon Laboratories, Caniff and Grand Trunk Ry., Detroit, Mich. The principal contents pertain to: Waterproofing, Damp-proofing, Oilproofing, Technical Finishes, Chemical and Metallic Floor Hardeners, Protective Steel Coatings, and Architectural Varnishes.

Hug Turntable and Hug Subgrading Machine.—These two machines, designed and constructed by a successful road builder, The Hug Co., of Highland, Ill., are illustrated and described in a 4-page pamphlet. It is claimed that the subgrader will save the labor of 10 men a day and that it will also save concrete, on road construction. It trims the subgrade true to grade. The cutting depth is adjustable. It is equipped with special crank axle and wheels, providing easy transportation. The turntable will turn a loaded truck on the truck's own power. It protects the finished subgrade. It does not require a track. It occupies only 7½ ft. width on the road and can be moved by two men. It speeds up the job and fewer trucks are required with it than without it.

Continuous Roofing Kettle.—The Iroquois Continuous Roofing Kettle, manufactured by the Barber Asphalt Co., Land Title Bldg., Philadelphia, Pa., is illustrated and described in a four-page pamphlet. It is claimed that revolutionary ideas are embodied in this kettle and that roofers and other users of asphalt melting kettles can derive economies from it.

Concrete Mixers.—Catalogs illustrating and describing their lines of Builders' Mixers and Boss Heavy Duty Type Mixers have been issued by the American Cement Machine Co., Inc., Keokuk, Iowa.

LOCK BAR PIPE

An agreement has recently been reached between the East Jersey Pipe Co. and the Riter-Conley Co., whereby "Lock Bar" Steel Pipe, which has been exclusively controlled by the East Jersey Pipe Co. since its introduction into this country in 1905, and has been hitherto manufactured by the East Jersey Pipe Co. at its plant at Paterson, N. J., will be hereafter fabricated in the Pittsburgh district by the Riter-Conley Co. at its Leetsdale plant. This is regarded as a step forward by both parties as it will permit considerable saving in freight rates and economy in manufacturing. "Lock Bar" Pipe has enjoyed a consistently increasing demand as a carrier for both water and gas, and the entire water supply of many a city in this country and Canada is dependent upon its "100 per cent joint." The sale of "Lock Bar" Steel Pipe will continue to be exclusively in the hands of the East Jersey Pipe Co.

$190,000,000 FEDERAL AUTHORIZATION AIDS ROAD CONSTRUCTION

Federal aid for road construction will be continued as a result of the authorization of additional appropriations for this work amounting to $190,000,000 carried by the Post Office appropriation bill signed by President Harding June 19, 1922. Fifty million dollars is authorized for the fiscal year beginning July 1, this year, and $65,000,000 and $75,000,000, respectively, are authorized for each of the two succeeding fiscal years. In addition, $6,500,000 is authorized for forest roads for each of the two fiscal years beginning July 1, 1923, and July 1, 1924. The funds will be administered by the Secretary of Agriculture through the Bureau of Public Roads.

The apportionment to be made to the various States is approximately as follows:

	Fiscal Year Ending 1923.
Alabama	$ 1,035,614
Arizona	702,188
Arkansas	836,095
California	1,641,399
Colorado	894,117
Connecticut	320,599
Delaware	243,750
Florida	591,217
Georgia	1,331,972
Idaho	625,691
Illinois	2,164,187
Indiana	1,305,904
Iowa	1,401,915
Kansas	1,401,521
Kentucky	944,786
Louisiana	664,660
Maine	463,440
Maryland	427,086
Massachusetts	730,784
Michigan	1,499,688
Minnesota	1,415,731
Mississippi	863,271
Missouri	1,632,086
Montana	1,031,257
Nebraska	1,054,126
Nevada	635,624
New Hampshire	243,750
New Jersey	628,581
New Mexico	793,216
New York	2,464,299
North Carolina	1,139,556
North Dakota	776,476
Ohio	1,882,003
Oklahoma	1,168,226
Oregon	788,443
Pennsylvania	2,265,969
Rhode Island	243,750
South Carolina	707,492
South Dakota	802,707
Tennessee	1,098,461
Texas	2,950,115
Utah	566,278
Vermont	243,750
Virginia	971,219
Washington	735,806
West Virginia	534,906
Wisconsin	1,263,211
Wyoming	623,078
Total	$48,750,000

These funds must be matched by the States and will be administered subject to the general provisions already in force.

Features of New Legislation

The new legislation reduces the maximum participation on the part of the Government from $20,000 to $16,250 per mile for roads constructed with the appropriation for the next fiscal year and $15,000 per mile thereafter. Bridges over 20 ft. in span may be considered as separate projects to which this limitation does not apply. In States where more than 5 per cent of the area is unappropriated public land provision is made for an increase in the amount per mile. The act also provides for the extension of Federal aid to the construction of structures required for the elimination of railroad grade crossings.

Important provisons of previous acts under which large funds have been successfully administered are applicable to the new funds. States must maintain adequate highway departments. Funds to match Federal aid must be placed under the direct control of the State highway department. The type of surface constructed must be adequate for the traffic anticipated, with reasonable grades, curves and other features. States must obligate themselves to maintain all Federal-aid roads constructed, and in case this is not done any Federal funds available for new projects may be withheld until they are put into satisfactory condition. All Federal-aid funds must be spent on a connected system of roads consisting of not more than 7 per cent of the total mileage in each State and divided into primary or interstate roads and secondary or intercounty roads.

Plans Received from All but Eight States

Plans for the proposed system have been received by the Bureau of Public Roads from all but 8 States, and the State systems are being coordinated so that when joined together they will serve the best interests of the whole country. In the meantime only projects certain to be on the proposed system are being approved.

The new apropriation comes at a time when several States are nearing the limit of funds available. The authorization of funds for three years in advance will be of great benefit to all States in that it will permit them to lay their plans for some time ahead. Uncertainty as to future Federal aid is removed and provision can be made at once for raising State funds to match it.

What the new funds will mean to the country can be judged by the use that has been made of the $350,000,000 previously appropriated. On May 31, 17,000 miles of road had been completed, and, in addition nearly 14,500 miles were

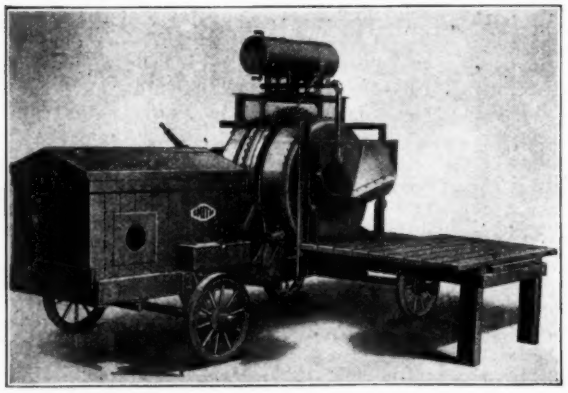
under construction. Federal-aid roads in all stages total nearly 38,7000 miles, involving over $287,500,000 of Federal aid. To match this fund, the States have appropriated approximately $380,000,000, making a total of $667,500,000.

All types of road have been constructed with Federal aid to meet the varying conditions in the United States. The average cost per mile has been $17,120, and Federal aid has amounted to 43 per cent of the total cost.

It is estimated that the $190,000,000 lately authorized will result in the construction of more than 25,000 miles, which added to the 46,000 miles that is expected to result from previous appropriations makes a total of 71,000 miles, or nearly 40 per cent of the estimated 180,000 miles of road in the system of Federal-aid roads now being outlined.

CONCRETE MIXERS WITH RUBBER TIRES

Smith 7-S Mixers, made by the T. L. Smith Company of Milwaukee, are now being furnished with rubber tires when desired. The fact that this type and size of mixer is used to such a great extent for city and town concrete jobs such as building foundations, curbs, culverts, bridge approaches, etc., requires considerable transportation from one location to another. The rubber tires make the transportation easier and quicker besides saving unnecessary jarring of the mixer.



SMITH 7-S (one bag) MIXER WITH RUBBER-TIRED WHEELS.

BIG ROAD PROGRAM IN TENNESSEE

The State of Tennessee has inaugurated a new Federal aid road building program involving the expenditure of $8,000,000 for 281 miles of roads in 20 counties. While this program is being carried out a campaign is under way to increase the State Highway Fund by means of a gasoline tax and a bond issue. This movement has the support of the automobile clubs of the state and the Tennessee Good Roads Association. The highway department of the State recently let contracts for 138.86 miles of bituminous macadam roads in the vicinity of Altamont, Ashland City, Elizabeth, Erwin, Greenville, Huntington, Kingston and Dandridge, the cost of which will be $4,884,500.

CALIFORNIA IMPROVES THE SURFACES OF ITS ROADS

The California State Highway Department has begun a systematic widening of state highways in many parts of the State and has adopted the Maryland policy of surfacing some of its concrete roads with asphalt. California has also begun work on a considerable mileage of bituminous macadam. In Glenn County 3½ miles of road will be of bituminous macadam, 5 ins. thick and 20 ft. wide. Five miles of concrete road in Placer County will be surfaced with 3 ins. of asphalt. The same treatment will be accorded three miles between Fairfield and Vacaville, in Solano County. In Sonoma County, 3 miles north and 1¼ miles south from the Petaluma city limits, a total distance of 4½ miles of concrete road will be widened to 20 ft. and surfaced with asphalt. Four and one-half miles of concrete road in Santa Clara County, near Carnadero, will also be surfaced with asphalt. Similar treatment will be given 16 miles of concrete roads in Merced, Madera and Kern counties.

Contracts Awarded

ROADS AND STREETS

Cal., Newport Beach—Independent Asphalt Paving Co., Seaboard Bldg., Seattle, Wn., awarded contract for paving Central Ave. and other streets, at $459,960.

Cal., Oxnard—Southwest Paving Co., 415 Washington Bldg., Los Angeles, awarded contract for paving various streets here, at $128,363.

Cal., Sacramento—Kaiser Paving Co., Oakland, awarded contract for paving with bituminized macadam 17.18 mi. state hwy. Kern Co. bet. Junction Pumping Station and Hart, at $380,322; Nevada Contr. Co., Fallon, Nev., awarded contract for grading 5.8 mi. state hwy. in Tulare Co. bet. Three Rivers and Sequoia Nat. Pk. at $121,173.

Cal., Sacramento—Pacific Constr. Co., Oakland, awarded contract for an 8-mile stretch from westerly boundary to San Luis Creek at $125,580; Blanco & Taylor, Vallejo, awarded contr. for 13 miles from the creek to Los Banos, at $216,550.

Cal., Woodland—A. Teichert & Son, Sacramento, awarded contr. by Yolo Bd. of Supvrs. for constr. of 4 mi. improved hwy. bet. bypass and Waldek's barn along Sacramento river; also for rd. impvt. in Washington, at $112,000. River road contr. calls for aspg. surf. and amounts to $112,000.

Fla., Ocala—Barber, Fortin Co., Warren, Ohio, awarded contr. by Marion Co. Commrs. for paving 20 miles State Rd., 2—Belleview to Lake County line; lime rock compacted, at $164,090.

Fla., Orlando—Following contracts let by Orange Co. Commrs: grading East Coast Rd. from Bithlo to Brevard Co. line, to E. W. Barker, Tampa, at $63,400; extending Oakland-Winter Garden Rd. to Lasley Bros. and Harvey of Chattanooga at $320,000 for 16-ft. brk. hwy.; W. P. McDonald Constr. Co., for constructing asph. road near Windermere, at $121,560.

Fla., St. Augustine—Jas. V. Wilson Co., awarded contract (tentative) by Co. Commrs. for constr. of upwards of 50 mi. hard surf. roads in St. Johns Co., contingent on bonds being voted by the people. Contr. price is $456,472.

Fla., St. Petersburg—Georgia Engineering Co., awarded contract of 3.840 ft. vitr. brk. paving at $306,652.

Fla., Starke—Barber Fortin Co., Gainesville, awarded contr. for hard surfacing Marion County's part of road No. 2 from Belleview to Lake Co. line, (16 miles) at $165,000.

Ida., Boise—Morrison & Knudson, Boise, awarded contract for 21 miles bet. Tamarack and Round Valley, Adams Co., at $134,972.

FOR SALE

Best 60 H.P. Track-laying tractor, overhauled, repainted, practically as good as new. Immediate delivery. For price and special terms, address

H. W. Chown,
305 Merchants Bank Bldg.,
Indianapolis, Ind.

Ida., Nampa—Jack McGuire, Idaho Falls, awarded contract for paving 31 blocks city streets with bithu lithic paving, at $157,410.

Ill., Springfield—Capital Constr. Co., Des Moines, Ia., awarded contract for 6 miles paving in Henry Co., at $125,199; J. E. Crane, Murphysboro, awarded contract for 4.8 mi. Route 2, Sec. 12; also 8.6 mi. Sec. 13, at $396,732; M. Haynes & Son, Janesville, Wis., awarded contract for 6.47 mi. on Route 2, Sec. 4, Union-Pulaski Cos., at $115,928; 3.67 mi. on Sec. 15 in Pulaski Co., at $66,712, and 6.95 mi. on Sec. 16 in Pulaski Co., at $137,901.

Ia., West Union—A. Carlson, Marshalltown, awarded contract for paving, curbing and guttering, at $122,796.

Ky., Frankfort—Following contracts let for road impvts.: Harlan-Pineville Rd., Harlan Co. to Dempster Constr. Co., at $93,918; Geo. M. Eady Co., Louisville, Ky., for Glasgow-South Rd., at $189,079; Costello Bros. Co., Knoxville, Tenn., contr. for Caldwell Co., Princeton-Marion Rd., at $57,211; Grayson-Olive Hill Rd., (2 brdg. approaches to Thomas Co. on Barrett's Creek only, at $17,780; Hopkinsville-Elkton Rd., Christian Co. to N. E. Stone Co., Madisonville, Ky., at $37,450; Estill Co., Irvine-Richmond Rd., macadam to Connelly Const. Co., Somerset, Ky., at $69,841 and surf. treatment to R. B. Taylor Co., Louisville, at $3,910; Henderson Co.-Louisville-Paducah Rd. to Taylor-Petrie & Co., Lewisport, Ky., at $14,457; Laurel Co., London-Mt. Vernon Rd., to Vermillion Constr. Co., Barbourville Ky., at $20,410; Rowan Co.., Morehead-Grayson Rd., at $70,695. Surface treatment awards as follows: Bell Co., to Southern Oil & Tar Co., Louisville, at $9,361; Bourbon Co., R. B. Tyler Co., Louisville, $6,432; Jefferson Co., Southern Oil & Tar Co., Louisville, $10,666; Nicholas Co., R. B. Tyler Co., $7,228; Shelby Co., R. B. Tyler Co., $2,850; Todd Co., R. B. Tyler Co. No. 3215; Cumberland Co., Alexander & Beck, Marrowbone, Ky., $16,780.

Mass., Boston—J. E. Watkins, Amesbury, awarded contract by State Hwy. Dept. for road work in Middleton, at $29,397; Lane Constr. Co., Meriden, Conn., awarde contr. for Dalton & Windsor rd. work, at $161,958.

Mass., Boston—State Hwy. Dept. let following

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The Non-Skid Ink Stand

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is of particular value to drawing ink users who work on a slanting drawing board.

It will not slide unless the board is inclined to an angle of more than 27½ degrees.

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K TRADE MARK

contracts: M. McDonough, Swampscott, awarded contr. for constr. of 3,260 ft. state hwy., in Andover; granite blk. and rein. conc., at $108,511; J. T. Quinn, Ashton, R. I., 23,354 ft. Mohawk Trail, Route, Shelburne, bitum. mac. at $219,349; Hoyt Constr. Co., 85 Dartmouth St., Holyoke, awarded contract for 17,550 ft. bitum. macadam hwy., Williamstown and New Ashford, 18 ft. at $127,604.

Mich., Lansing—Following road impvt. contracts let: Rd. No. 37-6, Kent Co., Caledonia Twp. C1 F rein. conc. 18 and 20 ft. 2.688 mi. to A. E. Green, Grand Rapids, at $48,991; No. 21-17, Lapeer Co. Imlay Twp. C1 F rein. conc. 18 ft., 2.332 mi. to C. D. Brooks, Omer, Mich., at $44,177; Rd. 24-20, Mecosta Co., Norton Twp. C1 B gravel, 16 ft. 1.022 mi. to Wilson Luxom, Lakeview, Mich., at $9,799; No. 86-1, Mecosta Co. Millbrook Twp. Cl. B gravel, 16 ft. 5.983 mi. to Whitney Const. Co., Grand Rapids, at $49,328; Rd. 14-26 Jackson Co., Summit Twp. C1. B gravel, 16 ft. 2.932 mi. to Townsend-Shuttleworth-Ballmer Co., Lansing, Mich., at $21,184; Rd. 19-12, Sanilac Co., Speaker Twp., C1. B gravel, 16 ft. 5.886 mi. to Moore-Elmer Constr. Co., Snover, Mich., at $58,985; No. 14-15, Benzie Co., Joyfield Twp. C1. B gravel, 16 ft. 1.005 mi. to Regan-Baker Co., Kewadin, Mich., at $7,915.

Minn., Winnebago—Following contracts let for paving and curbinb in various districts: (1) Grading and paving to Hanlon & Oakes, 338 Lmbr. Exch., Minneapolis, asph. conc. Cl. C, at $100,642: Main St. Dist. Grading 2,275 cu. yds., Paving, 15,004 sq. yds.; W. Cleveland St. Dist., grading 2426 cu. yds. Paving, 11,376 sq. yds., Cleveland St. Dist. Grading 2500 cu. yds. paving, 8080 sq. yds. (2) Curbs, Simeonson & Larson, $14,135.

Miss., Bay Springs—Myers Constr. Co., Hattiesburg, Miss., awarded contract for 14.3 miles gravel surfaced road bet. Meridian and Hattiesburg, at $140,000.

Nev., Carson City—Phelps Constr. Co., Salt Lake City, awarded contract at $110,126 for constr. of Rte 1, Sec. B, 19.83 mi. Elko Co., at $110,126; J. H. Causton, Lovelock, Nev., contract for Rte. 2, Sec. C-2, 15.01 mi. in White Pine Co. bet. Illipah and Robinson's Summit, at $93.027; Nevada Contracting Co., Fallon, Nev., awarded contract for constr. of Rte. 2, Sec. B, 22.95 mi. in White Pine Co. at $174,778.

N. J., Camden—Corson & Sutton, Ocean City, awarded contract for paving Landis Ave. at $254,000.

N. Y., Albany—Neilan Brothers, Tonawanda, awarded contract for impvt. of Fredonia-Silver Crk. rd., parts 3-A and 3-B, at $146,165.

N. Y., LaSalle—F. J. Mumm Constr. Co., Buffalo, awarded contract for paving with conc., 2 miles section of Military Rd., at $48,546; Walter C. Rich, Youngstown, awarded contract for constr. of improved river road bet. Niagara Falls and No. Tonawanda—approx. 5½ miles at $226,900. German Rock Asphalt Co., Buffalo, will in all probability, be given contract for International Railway Company's share of the River Rd. paving, which Includes strip 19 ft. wide along side and bet. tracks from Niagara Falls city line east to present Cayuga Crk. brdg.

N. Y., Niagara Falls—Following is City Manager's report approved by Council: That contract for paving 18th St., be awarded to Read-Coddington Engrg. Co. at $47,528 for sheet asph.; contr. for paving Falls St. to same company at $75,999 for sheet asph. pavement; contr. for paving Ferry Ave. to same company at $47,923 for sheet asph. pavement; contr. for paving Mackenna Ave. to J. F. McKinney Corp. at $17,588 for 3-in. vert. fibre brk. pavement; contr. for paving LaSalle Ave. to same corporation, at $49,279 for 3-in. vert. fibre brk. pavement.

N. Y., Yonkers—The Jas. J. Hart Constr. Co., City, awarded 3 contracts by State: 1 contract for paving state roads within village of Port Chester, at $155,000; the other two for constr. of brdg. over Byram River at $5,700 and for constr. of sewer along thorofare in Pt. Chester that is to be paved, at $17,000.

N. C., Asheville—Asheville Paving Co., awarded contract to pave Southside Ave. with 7-in. conc. base and Biltmore Ave. with 6-in. conc. base at $125,000.

N. C., Raleigh—State Hwy. Comn. let following contracts for road work No. 110—Pasquotank Co. 2.71 mi. hard surf. road betw. Elizabeth City and Camden Co. line, to J. L. Gehee, at $117,364; structs. to G. E. Ward at $18,626; 340—Cumberland Co., 11.07 mi. hard surf. rd. bet. Fayetteville and Hoke Co. line to Alabama Conc. Products Co., at $334,714; structs. to Hobbs-Peabody Constr. Co. at $11,004; 312—Brunswick Co., 9.77 mi. hard surf. rd. from Leland to Columbus Co. line to Alabama Conc. Products Co. at $302,834; structs. to Batson-Cook Co., at $14,372; 316—Brunswick Co. 12.12 mi. gravel rd. on Wilmington-Charlotte-Asheville Rd. to B. F. Price, at $45,115; structs. to Batson-Cook Co. at $25,133; 364-B, Onslaw Co., 12.84 mi. gravel rd. betw. Dixon and Jacksonville to A. W. McClay, at $49,452 and for structs., at $40,432; 502—Alamance Co., 17.43 mi. gravel rd. bet. Graham and Randolph Cos. to W. N. Thompson, at $67,939; structs. to Hanford Bros., at $62,078; No. 545, Hoke Co., 9.20 mi. gravel rd. bet. Raeford and Scotland Co. line to A. W. McClay at $35,347; structs., at $16,281; No. 593—Rockingham Co., 17.60 mi. hard surf. rd. bet. Reidsville and Va. State line to J. A. Krees, at $447,630; 614—Cabarrus Co., 9.20 mi. hard surf. rd. from Concord to Mecklenburg Co. line, to G. L. Harris, at $280,845; structs. to Oliver-Costello Bros., at $37,703; 670—Cabarrus-Rowan Cos., 4.53 mi. hard surf. rd. from Kannapolis to Luther's Church, to Southern Constr. Co., at $128,642; 741—Forsyth Co., 8.90 mi. hard surf. rd. bet. Hanes and Davie Co. line, to Hardaway Constr. Co., at $265,041; structs. to Mills-Williams Constr. Co., at $21,030; 742—Forsyth Co., 10.62 mi. hard surface rd. on Boone trail from Winston-Salem to Yadkin River to A. J. Wardrup, at $384,399; structs. to Stearnes Bros., at $15,136; 888 Yancey Co., 15.22 mi. hard surf. rd. from Swiss to So. Toe River, to R. S. Freeman, at $97,970; structs. at $42,933; 913—Cherokee Co., 10.33 mi. waterbound macadam rd. to Mills-Williams Constr. Co., at $86,868; 953—Jackson Co., 12.772 mi. grade and construct bridges from Dillsboro to Macon Co. line, to C. C. McCabe, at $87,715; structs. to A. E. Wilson, $17,997; 954—Jackson Co. 1.68 mi. hard surf. rd. bet. Sylva and Dillsboro to Mills-Williams Constr. Co. at $66,764; structs. at $15.676.

N. C., Rockingham—Hedrick Constr. Co., Burlington, awarded contr. for paving various streets with sheet asph. on 5-in. conc., at $160,229; Slattery & Henry, Greenville, awarded contract by Sumter Co., Sumter, S. C., for paving 3.64 miles Stateburg Rd. with asph. at $100,000; Powell Paving Co., Centerville. contr. for asph. surfacing 6½ mi. Pinewood & Camden Rds. at $150,000.

Rd. to Westrick, Krauss & Shreves, Napoleon, at

O., Columbus—Following contracts awarded by Director of Hwys.: 3 mi. brk. on Lima-Sandusky $97,432; Auglaise Co. 6½ mi. macadam on Lima-Wapakoneta Rd. to H. E. Pratt Co., Mt. Blanchard, at $147,528; also 5 mi. brk. on Sidney-Wapakoneta Rd. to Radebaugh-Graham Co., Columbus, at $191,161; Carroll Co. 3 mi. brk. on Minerva-Sandyville Rd. to Chester General Contg. Co., E. Liverpool, at $87,719; also 2½ mi. brk. on Carroll-Malvern Rd. to same company at $100,150 and 4 mi. brk. on Carrollton-Malvern Rd. at $157,425; Coshocton Co. 3 mi. brk. on Newark-Coshocton Rd. to V. C. Smith, Dayton, at $125,610; Hancock Co. 2 mi. conc. on waterbound base on Findlay-Kenton Rd. to H. E. Pratt Co., Mt. Blanchard, Medina Co. 2½ mi. conc. on Ashland-Medina Rd. to Crum & Woods, Lodi, at $77,931; Morgan Co., 2 mi. macadam on Malto-Glouchester Rd. to Miller & Rothrock, Ada, at $48,804; Perry Co. 3 mi. conc. on Zanesville-New Lexington Rd. to Newark Paving & Constr. Co., at $102,144; Sandusky Co., 3 mi. brk. on Fremont-Oak Harbor Rd. to Modern Constr. Co., Fremont, at $114,755; Seneca Co. 1½ mi. macadam on Columbus-Sandusky Rd. to Central Paving Co., Hamilton, at $28,477; Union Co. 4 mi. macadam on Marysville-Marion Rd. to L. G. Rockholt, West Mansfield at $99,827; Wayne Co. 2 mi. brk. on Akron-Wooster Rd. to Harry Gilbert, Akron, at $56,115; also 3 mi. conc. on Orrville-Northern Rd. to E. M. Shaffrey Co., Akron, at $105,606.

Okla., Oklahoma City—Beekman Constr. Co., awarded contract for paving Edmond Rd., 6½ miles. Bid for 6 miles of the work was $237,000 and this was reduced on a pro rata basis to cover the 4½ mi. Road will be built with 5-in. conc. base and 3-in. vert. fibre brk. surface.

R. I., Providence—T. J. Quinn & Sons, Ashton, awarded contract to construct 20,000 ft. state hwy. on stretch known as Cummington and Goshen Rd.

co. of Shelburne Falls, Mass., to T. J. Quinn & Sons, at $221,051.

S. C., Charleston—J. M. Gregory & Co. awarded contract for constr. of conc. hwys. in St. Andrews Parish from 8-mi. post to John's Isl. crossing and exten. of Meeting St. Rd. to the Blue House rd., at $33,000; contr. to same contractor for exten. of project in St. Andrews Parish at $158,282.

Tenn., Nashville—Boyd Williams, Murfreesboro, awarded contract for bldg. 6.61 miles bitum. macadam rd. Cannon Co., at $160,903. 8-in. hand-placed base course will be used; bridges of more than 20-ft. span, awarded to J. B. Ramsey, Fayetteville, at $73,743; 8.91 mi. rd. Bledsoe Co., awarded to R. S. Freeman & Co., Knoxville, at $240,621; bridge, to Luten Bridge Co., Knoxville, at $14,721.

Tex., Breckenridge—Womack Constr. Co., Dallas, awarded contract for paving at $303,595. All the main streets in city will be paved.

Tex., Dallas—Scarborough & Davis, awarded contr. for construction of Seagoville Rd. at $164,938. Company will pave entire distance of 18 miles with exception of small strip in White Rock bottom which will be paved with conc. and which will be let as separate contract.

Tex., McKinney—Tibbets Constr. Co., Ft. Worth, awarded contr. for road constr. work on the Five A Hwy. thru Collin Co., at $385,000.

Utah, Provo—Reed & Gibbons, Salt Lake City, awarded contr. for paving 6.6 mi. rd. from Spanish Fork to Payson via Banjamin, at $150,000. Paving will be a 4½-in. black base with 1½-in. bitulithic top.

Va., Big Stone Gap—Flenniken Constr. Co., awarded contr. for abt. $100,000 street paving here. Contr. includes grading, macad. base and asph. surfacing on abt. 2½ miles of streets. Contractors are located at Knoxville, Tenn.

Va., Woodstock—J. E. Lane & Co., Altavista, Va., awarded contr. by State Hwy. Comn., for constr. of Little River Turnpike betw. Alexandria and Fairfax, C. H., 11 1-3 miles, at $324,000.

SEWERAGE AND SEWAGE TREATMENT.

Cal., Dinuba—Federal Constr. Co., Call Bldg., San Francisco, award. contract for constr. of sewage disposal plant, at $134,900. Former contract rescinded.

Ont., Hamilton—Contract for constr. of pipe sewers in King William, Stirton, Dalhousie and Gore Sts., also Campbell Ave., awarded to Jno. Maguire Contracting Co., Ltd., Toronto, at $187,433.

Ga., Atlanta—McDougald Constr. Co. awarded contract for sewer work at $124,650 (exten. of Lloyd St. sewer; at $11,907 to J. B. McCrary Co. for Stewart Ave. trunk sewer exten.; at $27,182 to Dysard Constr. Co. for constr. of small lat. sewers.

Kans., Clay Center—Reed & Whitlock, Clay Center, awarded contract for installation of sewer and other municipal work at Sharon Sprgs., Kans., Wallace Co., at $50,000.

Md., Baltimore—Wash. Suburban San. Comn., Wash., D. C., let contract for sewer and water constr. in Maryland as follows: Sewerage in Brentwood Cottage City and nearby territory, Prince George Co., at $54,573; Riverdale, at $41,834 to E. C. Baker, Uniontown, Pa.; water mains for sect. 3 and Martin's Addn. to Chevy Chase and Woodmont, at $73,765, to Phillip A. Crieves, New York; also contr. at $9,128 for water mains from Takoma Pk. filter plant to connect with main being laid from Silver Sprgs. toward Chevy Chase, etc.

Md., Hagerstown—Harry Angle, Hagerstown, awarded contract to construct sewerage system at $117,930.

River Rouge, Mich.—H. W. Watts, River Rouge, awarded contract for 7,000 ft. trunk sewer in Jefferson and Stoner Aves., 3-6 ft. diam. at $100,000.

Springwell, Mich.—Cooper-Widemann Constr. Co., 1430 Penobscot Bldg., Detroit, awarded contract for sewage treat. plant, Sec. 7, at $238,500.

N. Y., Long Isl. City—J. A. Gross, 8518 Fulton St., Woodhaven, awarded contract for sewers in Kingsland Ave. at $7,650; stormwater sewer in Borden Ave., to J. Gallo, 203 Division St., Brooklyn, at $75,386.

N. J., Clifton—Frank B. Beasman Co., Baltimore, Md., awarded contract for sanitary sewer system here, at approx. $750,000. Total cost of sewer work will be one million dollars.

N. M., Lordsburg—Jack Heather, local, awarded contract for constr. of sewer and water systems here, at $68,556.

N. Y., Canandaigua—Rochester Vulcanite Pavement Co., Rochester, awarded contract for sewage disposal plant and sewers, at $75,930.

N. Y., Mamaroneck—Francis Donaldson, New York, awarded contracts for disposal works; S. Wardell & Co., Stamford, Ct. contract No. 2, outfall extensions; Louis Petrossi & Co., Hartford, Conn., Contr. No. 3, sewers, at $116,955, $89,253, $72,427, respectively.

O., Akron—A. W. Morette, 23 E. Exchange St., awarded contract for 3430 ft. 30-72 in. brk. and 7,000 lin. ft. 6-24 in. vit. clay sewer in Wolf Ledge Run Sewer Dist., at $58,657.

Okla., Henryetta—City let following contracts for impvts. to sewer system: $26,700 to I. E. Hanson, Ada, Okla., furnishing material and installing san. sewer system; at $72,000 to Park & Horan, Okmulgee, Okla., for material, consisting of segment sewer blocks for installation of storm sewer mains; at $41,900 to Morkle Machinery & Contg. Co., Kansas City, Mo., to install sewage disposal plant.

Okla., Okla. City—Municipal Excavator Co. awarded contract at $115,035; White & Evans, contr. for First St. main sewer at $10,338.

Va., Richmond—Contract for sewers in Grace St., 9th to 1st Sts., including 1660 lin. ft. 30-36 in. segment blk. and 768 lin. ft. 15--24 in. terra cotta pipe, to Wingo & Deaner, P. O. Box 816, at $36,271; Main St., 8th to 13th Sts., 1586 lin. ft. 30-42 in. segment blk. to Kelly & McLane, 800 W. Cary St., at $40,452; 9th St., Main to Grace Sts., and Franklin St., 7th to 9th Sts., 1362 lin. ft. 24-30 in. segment to A. J. Boyle, 102 Wetmore Ave., Baltimore, Md., at $24,544.

WATER SUPPLY AND PURIFICATION.

B. C., Sumas—Dominion Engrg. Works, Montreal, Que., awarded contract for complete pumping plant for Sumas Dyking Comn., Kilgard, D. C., at $115,000.

Conn., Kensington—J. E. Driscoll, 499 Prospect St., Torrington, awarded contract for extending water supply sys.; castings, pipes, etc., to U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.; fittings, etc., to Builders Iron Fdry., 9 Codding St., Providence, R. I.; valves, etc., to Ludlow Valve Co., Troy, N. Y.; hydrants, etc., to A. P. Smith Mfg. Co., East Orange, N. J. Total, $100,000.

Ct., Stamford—H. Steers Corp., 17 Battery Pl., New York, award. contract for constr. of conc. dam and appurts. across Mill River in Stamford and New Canaan at Highbridge; 2,000,000,000 gal. capy. reservoir. Engrs.' Est. $750,000.

Ia., Cedar Rapids—Jno. Klepach Constr. Co., local, awarded contr. for bldg. 7,500,000 gal. water reservoir at $99,720.

Fla., Jacksonville—Waterworks impvts. contracts let as follows: Earth dam, control works and appurts. to F. P. McElwrath, Corsicana, at $40,363; pump and filter plant bldgs., basins, etc., to R. C. Newcomb, Dallas, at $29,994; cast iron pipe and fittings to U. S. Cast Iron Pipe Co., Scolland Bldg., Dallas, at $15,984; valves, hydrants, etc., to Darling Valve Co., Ft. Walnut St., Williamsport, Pa., at $1,744; furnishing jointing materials to Briggs-Weaver Co., 307 N. Market St., Dallas, at $981; installing piping, hydrants, valves, jointing materials, etc., to be done by day labor, care T. E. Acker, Mayor, at $4,500; pipe gallery, filter plant fittings and valves to Morey & Morey, Dallas, at $3,743; erecting fuel oil tanks to Pittsburgh-Des Moines Steel Co., Curry Bldg., Pittsburgh, Pa., at $9,400. Will award contract later for elec. driven pumps and motors in place. Bids rejected for oil engine and pump in place.

Md., Baltimore—U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J., awarded contract for 8,000 tons cast iron pipe at $417,875; A. P. Smith Mfg. Co., E. Orange, N. J., contract for $50,000 worth of valves in connection with reservoir to be built no. of Druid Ridge Cemetery to supply Pikesville, Forest Pk., Arlington and other northwest sections, capy. 20,000,000 gals.

Mich., Monroe—A. Bentley & Sons Co., Toledo, awarded contract for constr. of filtr. plant and pumping sta., in connection with water works system, at $129,171.

Mich., Monroe—Kitchell Constr. Co., Kalamazoo,

awarded contract for 3,000,000 gal. capy. rein. conc. and pipe line extensions at $500,000.

Minn., St. Paul—Allis-Chalmers Mfg. Co., 707 Met. Life Bldg., Minneapolis, awarded contracts to 3 pump units at McCarrons pumping sta., with all accessories, at $140,700.

Mont., Red Lodge—McLaughlin & O'Neil, Livingston, awarded contr. for 13,020 ft. 6, 8 and 10-in. cast iron pipe, 8,900 ft. 8 or 10-in. cast iron pipe, 1 clear well, 2 pressure regulators, at $63,106.

N. M., Lordsburg—Jack Heather, local, awarded contract for constr. of water and sewer systems here, at $68,556.

N. Y., No. Tonawanda—Contr. to Hydro Constr. Co., Mutual Life Bldg., Buffalo, for excav., grading and conc., work for filter plant, pumpg. sta. addn. and wash tank at $89,2888; superstruct. for filter plant and pumping sta. addn., at $30,920; superstruct. and found. for addn. to boiler rm., $3,390; Pitt Constr. Co., Fulton Bldg., Pittsburgh, filter equipt. including settling basin and clear water basin equipt., outside piping for high and low serv., pumps, $74,000; plastering inside walls of pumpg. sta. addn., $1,500; automatic control apparatus, for coagulant machines, $1,200; rein. conc. flr. for portion of existing pumping sta., $20 per cu. yd.; Buffalo Steam Pump Co., 490 Bway., Buffalo, low serv. pumping engines, $10,328; Memphis Steel Constr. Co., Magee Bldg., Pittsburgh, Pa., wash tank, $3,550; S. D. Stafford, reconstructing dock wall, at $4,700.

N. Y., Wilson—Philip Agrious, Akron, O., awarded contract for constr. of village water and sewer systems, at $70,500.

N. C., Greensboro—W. W. Boxley Co., Roanoke, Va., awarded contract to construct dam at Reedy Fork, capy. 6,000,000 gals., at $83,346; Isaac Hardeman, Charlotte, awarded contract for constr. of complete pumping unit, at $8,496.

O., Columbus—Thompson-Starrett Co. 51 Wall St. New York award. contract for Contr. No. 10 O'Shaughnessy Dam and appurtenant works at $1,165,511. Work will include 122 tons cast iron water pipe, 21 tons flange special castings, 8 tons c. i. soil pipe, 15 tons c. i. soil pipe fittings, 200 lin. ft. W. S. pipe 2-in. and less, 4,500 lbs. galv. W. S. sockets, 4 30x60-in. sluice gates and 6 36x60-in. sluice gates, 90,000 lbs. iron castings, etc., etc.

Okla., Bristow—Burke Constr. Co., Okla. City and Gibson & Mitchell, Ponca City, awarded contracts for water and sewer systems, at $102,947.

Okla., Okla. City—Pratt-Thompson Constr. Co., Kansas City, Mo., awarded contract for gunnite conc. slabs to reinforce banks on lake at water works dam, at $187,005.

Okla., Vinita—Jas. Shoe, Miami, award. contract for water works system, at $256,000.

Tex., Paris—McGuire & Cavender, Kansas City, Mo., awarded contract to construct dam for new reservoir, at $251,516.80.

Wn., Monroe—Northwestern Constr. Co., Seattle, awarded contract for new water system at $66,714.

Wn., Mukilteo—Troutman & Co., Seattle, awarded contract for extensions to water system, including pipe line, at $56,000.

Wis., Milwaukee—Scoonmaker Constr. Co., 373 Bway., awarded contr. for Riverside Pumping Sta. (Pumping sta., excav., conc. foundation and sewerage), $1,500,000.

Wyo., Mills—Mills Constr. Co., Mills, awarded contract for conc. filter bed and mains; $70,000 bonds voted for project.

Prospective Work

ROADS AND STREETS

Ala., Birmingham—Paving of 5th Ave. So. at est. cost of $88,800 is provided in Ord. adopted by Comn. providing for paving street with sheet asph. on 5-in. conc. base. Space bet. rails of Birmingham Belt, which are to be removed, is to be paved with granite base. Ord. for paving N. 13th St.—8th to 11th Sts.—confirmed. Several additional paving Ords. have also been confirmed.

Ala., Decatur—Morgan County Bd. of Revenue will issue road bonds in sum of $409,000. Impvt. work expected to begin early next month. It is planned to begin work in each of the commissioner's dists. simultaneously. County projects will be built in addn. to ones contemplated by state and fed. governments.

Ala., Montgomery—State Hwy. Dept. plans 23.09 miles state hwy. from Jefferson Co. line to Chilton Co. line, at est. cost of $529,484; Chilton Co. bitum. macadam rd. from Shelby Co. line to Autauga Co. line, $580,460—both Fed. Aid Projects.

Cal., San Francisco—City and San Francisco Co. had plans prepared for impvt. of Taraval St.—37th to 48th Aves.; 6,228 lin. ft. conc. curbs, 655 lin. ft. 8-in. and 315 ft. 12-in. sewer pipes, 6,604 sq. ft. artificial stone walks, 180,930 sq. ft. asph. conc. pavement, etc., $72,000; Buchanan St.—Herman to Duboce Sts.—22,091 cu. yds. excav., 623 lin. ft. conc. curbs, 370 lin. ft. 8-in. vit. sewers, 4,364 sq. ft. vert. fiber brk. pavement and 7,715 sq. ft. asph. conc. pavement, $34,200. M. M. O'Shaughnessy, City Engr.

Ind., Brazil—Clay County Bd. of Commrs. have approved petition to pave E. National Ave. road from Ashley Street limit of brk. pavement east to Brazil Twp. line connecting with state hwy. sys. of conc. and National Old Trails sys. Geo. Shoehan appointed as engineer. Petition of Dr. Wm. Pal and others for impvt. of winding course thru Harmony, approved and road ordered surfaced with crushed rock.

Ind., Ft. Wayne—Impvt. resolutions, calling for paving 3 streets and 8 alleys, confirmed at meeting of Board of Pub. Wks.

Ind., Indianapolis—Resolutions confirmed for resurfacing with asphalt Delaware St.—24th to 25th Sts.; Georgia St.—Penn. to Delaware Sts.—with wooden blk. Board also adopted resolutions for perm. impvt. of Wade St.—Shelby to State Sts.; 32nd—Ill. St. to Boulevard Pl.; Oxford St.—10th to Brookside Parkway so. drive; Lockerbie St.—East to Liberty Sts.; 44th St.—College to Winthrop Ave.; 1st alley east of College—32nd to 34th Sts. and for resurfacing Washington St.—Liberty St. to 194 ft. east; also Delaware St.—19th to 22nd Sts.

Ia., Iowa City—Council voted to advertise for Muscatine Ave. paving. Alderman also voted in addition to this 11 blks. of paving, to secure bids on impvt. of portions of Grant, Bloomington, Jefferson, Dodge and Madison Sts.

Ala., Merrill—Ready for bids in near future for approx. 25,000 yds. paving. W. E. Buell Co. Cons. Engrs., 205 Davidson Bldg., Sioux City; Geo. W. Simpson, City Clk.

La., Pointe a la Hache—$235,900 road bonds sold (hwy. bonds of road districts 1 and 2 of Plaquemine Parish). The districts are on west bank of Mississippi River and extend from the Orleans-Jefferson Parish line down to Ft. Jackson reservation—75 miles. Surveys completed and road will be built speedily. The Quachita Parish police jury has decided on program for rd. bldg., calling for expendt. of approx. $825,000 for constr. of 46 miles of hwy. H. L. C. Daigre, Parish Engr.

Me., Gardiner—State Hwy. Dept. will build and maintain regulation State Rd. about 5 miles long bet. this city and Augusta line. It is understood that the road will be built at cost of $100,000.

Mass., Pittsfield—Order passed appropriating $68,000 for paving East Street—Wendell Ave. to 4th St. $288,000 available for paving impvts. here.

Minn., St. Paul—Prelim. orders for repaving 3 miles of streets at est. cost of $200,000, passed by Council.

Miss., Pascagoula—Jackson County Bd. of Supvrs. will advertise for bids for bldg. perm. hwy. across county. Road calls for expend. of approx. $750,000.

Mont., Helena—State Hwy. Dept. will call for bids in about 60 days for 3 Fed. Aid projects (about 50 miles) at est. cost of over $400,000. Surveys and plans completed on a number of the projects. Projects will all be surfaced.

Mont., Helena—Resolution passed by City Council to create West Side paving district. Costs estimated at from $76,500 for cement conc. to $142,500 for brick paving.

N. M., Albuquerque—Expenditures totaling $367,000 National Forest Hwy. funds for constr. of 64 miles hwy. in state, approved by Secy. of Agricult. Wallace.

N. J., Trenton—State expects to improve 145

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The.
Kissel Motor Car Co.
International Motor Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling & Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
American Appraisal Co.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Gannett, Seelye & Fleming Co.
Hill & Ferguson.
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Morse, Wm. F.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Direct Oxidation Process.
Direct Oxidation Process Corp.

Disinfectants.
Integrity Chemical Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg Co., W. E.

Drawing Materials.
Kolesch & Co.

Dryers.
Cummer & Son., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

miles of roads during 1922. Est. cost of year's constr. outlined under reimbursement contracts, will cost $8,200,000. Contracts have already been let for more than 70 miles, which represents an expendt. of $4,500,000. Bids have been asked for an additional 20 miles. County projects total 150 miles more.

Nev., Carson City—Plans completed on following projects: No. 15, West. Co. line to Vivian, Elko Co., 8.34 mi. grading; 22, West Co. line to White House, Eureka Co., 6 miles, grading and gravel surf.; 31, Eureka to Hayranch, Eureka Co., 12.2 mi. grading and gravel surf.; 4, 3 mi. no. or Carters to Holbrook, Douglas Co., 4 miles grading and 25% surfacing; 46, 6.9 mi. SE of Canyon to 3.6 mi. SE of Rose Well, Nye Co. 18.85 mi. grading; 26, Reno to Lawtons, Washoe Co. 4 mi. grading and grav. surf.; 16, West Co. line to Battle Mountain, Lander Co., 8.5 mi. widening grade and gravel surf.; 46, thru city of Yerington, Lyon Co., 1.5 mi. 18-ft. conc. surf. Projects for which plans are being prepared are as follows: Portions thru City of Elko, Elko Co., 18 ft. grav. 30-ft. rdway; Fallon to Grimes Ranch, Churchill Co., 10 mi., 15-ft. grav. surf.; thru city of Fallon, 1.24 mi., 18-ft. conc. surf.; Hazen to Wadsworth, Lyon, Churchill and Washoe Cos., 15.65 mi. grad'g. & grav. surf.; Grimes to Salt Wells, Churchill Co., 5.40 mi. 15-ft. gravel surf.

N. Y., Massena—City will expend $62,500 for paving 4 streets and bldg. storm sewer. Taxpayers have voted in favor of impvts.

N. C., Greensboro—Bids will be asked in about 30 days for 29 new streets—total of approx. 71,800 sq. yds., or about 4½ miles paving.

O., Massillon—City Council passed resolution authorizing Jas. E. Willison, City Solicitor, to instruct service dept. to place on file immediately the plans, specfs. and profiles of Massillon's $500,000 paving program, legislation for which has already been passed.

O., Toledo—City plans improving Summit Street for 11 blocks in No. Toledo. City Engr. Lewis Owen recommends 3-in. surf. of asph. on brick pavement.

Okla., Ponca—City Commrs. have received required petitions signed by 75% of prop. owners for paving about 11 blocks of streets.

Pa., Bethlehem—$2,000,000 Northhampton County bonds voted here for roads and bridges.

Pa., Catasauqua—Voters here approved bond issue of $120,000 for perm. street impvt. Borough of No. Catasauqua voted in favor of borrowing $350,000 for perm. street impvts.

Pa., Philadelphia—Bill for improving Delaware Ave. at cost of $750,000 is in City Council and will be acted on in a few days. Chf. Dunlap of Hwy. Bureau stated that plans are ready and work will be pushed. Work will include grading and paving, constructing sewers and other underground impvts., etc.

Pa., Phila.—Woodlynne Council considering bond issue in sum of $44,000 to carry on extensive street impvt. campaign. Voters have approved the issuance of the bonds.

Pa., Pittsburgh—Dept. Pub. Wks. has submitted measure to council which would authorize city asphalt division to prepare roadways on the two viaducts of the Boulevard of the Allies, at cost of $15,120. Council passed Ord. for impvt. of Pioneer Ave. at cost of $185,000.

Tenn., Nashville—State has inaugurated new Fed. aid rd-bldg. program involving expendt. of $8,000,000 for 281 miles of roads in 20 counties. This movement has support of the auto clubs of state and Tenn. Good Rds. Assn.

Va., Barton Heights (P. O. Richmond)—City has tentative plans for impvt. of streets, bridges, sewers, bldgs., etc., $1,500,000 available. Stewart White, Councilman; improve Steuart Rd. from North Ave. to Chamberlayne and Bartin from Poe St. to Boulevard.

Wash., Olympia—White Salmon Rd. bet. Husum and Trout Lake in Klickitat Co. will be constructed at cost of $150,000; county co-operating to extent of $100,000. National Forest Hwy. funds in sum of $575,000 made available for constr. of 50 miles of hwy. in Washington. For constr. of 5 mi. of rd. betw. Hughes and Orient, on Inland Empire St. Hwy., $50,00 will be expended from Fed. funds and an equal amt. from state co-operate funds. Three and one-half miles Republic-Wauconda Rd. will be surfaced at cost of $15,000.

W. Va., Wheeling—Approx. 1 mile of old Stone Church road will be paved this year. New paving will be of brick.

SEWERAGE AND SEWAGE TREATMENT.

Que., Montreal—City considering laying 8,624 ft. 2x3 brk. sewer in St. Joseph Blvd.—Henri Julien to Papineau Aves., $64,780. F. V. Dowd, Asst. Supt. Sewer Dept.

Cal., San Luis Obispo—$20,000 bonds voted here for sewer impvts.; also $15,000 for septic tank.

Fla., Miami—$214,000 will be expended for sewer construction here.

Ill., E. St. Louis—Resolution calling for constr. of sewer system in northeastern section of E. St. Louis known as Lansdowne, passed by Council. Proj. when completed will be 18 miles in length and will drain approx. 800 acres of land. Est. cost $504,000.

Ky., Henderson—Bids will be asked in about 60 days for constructing complete system of sewerage. Prelim. plans being prepared. Jno. A. Cunningham, Commr. Pub. Wks. & Prop.

Mass., Boston—Mayor has approved orders of Bd. of Street Commrs. for constr. work as follows: San. seewr 24-in. earthen pipe, surface drain 4-ft., 6-in., 4-ft. 3-in. and 3-ft. circ. conc. and 2' catch basins in Western Ave., bet. Telford St. and Everett St. in Brighton Dist. at est. cost of $15,000; overflow 6-ft. by 6-ft. conc. in Farragut Rd. exten. bet. 352 ft. northwest of E. First St. and 450 ft. northwesterly, in So. Boston Dist. at est. cost of $43,300; san. sewer of 1-ft. 6-in. by 1-ft. 3-in. conc. surf. drain of 1-ft. 6-in. by 1-ft. 6-in. conc. and 4 catch basins in Ipswich St. bet. 900 ft. west and southwest of Charlesgate W. and 740 ft. northeast and easterly in Roxbury Dist., est cost $6,765.

Minn., St. Charles—Plans being prepared for sewer system by Engr. Chas. L. Pillsbury Co., 1200 2nd Ave. S. Minneapolis. R. Dixon City Clk.

Minn., St. Paul—City Council passed order for installation of new sewer on Grand Ave.—Lexington to Avon—to replace present sewers. Est. cost of new sewer $21,055.

Mo., Cameron—Benham Engrg. Co., Kans. City, Mo., retained as Cons. Engrs. by City for impvts. to sewage disposal plant.

Mo., Kansas City—City will extend Blue Run sewer. Expend $2,000,000 for piping. Paul A. Hartung, Engr. Will construct $1,000,000 worth of additional sewers during year.

Mo., Kansas City—Park Board contemplates installing sewer along Swope Park. Est. cost $27,000.

N. Y., Gouverneur—Bd. Village Trustees plan to extend storm water and san. sewerage system. Est. cost $25,000 to $30,000. G. F. Dawley, Pres.

Neb., Grand Island—Ord. passed to create Sewer Dist. 80, from Clark to Broadwell Ave.—12th to 13th Sts. H. E. Clifford, City Clk. $300,000 bonds voted for storm, san. sewer system and sewage disp. plant here. H. E. Clifford, Clk. W. E. Buell, 205-7 Davidson Bldg., Sioux City, Ia., Engrs. Ord. also passed to create Sewer Dist. 79 from Oak to Locust St. bet. 14th and 15th Sts.

Neb., Wayne—At meeting of City Council it was decided to extend sanitary sewer into eastern section of town. Engineer will be retained to look after the work.

N. H., Manchester—Specfs. for new sewer project being worked out by Hwy. Surveyor Conant. Reinf. conc. pipe to be made at sewer job on Beech Street will be contracted for. Sewer work 1½ miles in length.

N. M., Artesia—$50,000 bonds voted for sewerage system and disposal plant. C. O. Brown, Mayor.

N. Y., Brooklyn—Final approval given by Boro. Pres. Connolly to plans and specfs. for 5 sewer extensions, two of which are in Corona, two in Flushing, and one in Ridgewood. Total est. cost will be more tha $50,000.

Ohio, Barnesville—City will install sewerage system at estimated cost of $450,000.

Ohio, Lima—City Comn. has adopted plans for direct oxidation sewage disposal plant.

Ohio, Maple Heights—Will advertise for bids in July for sewerage sys. Segment blk. and some brick. Also sewage treatment station. Est. cost $300,000. C. W. Courtney, Leader-News Bldg., Cleveland, Engr.

Okla., Muskogee—City will soon ask bids for about 9,000 lin. ft. sanitary sewers.

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E. Mfg. Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machin-
Good Roads Machinery Co., Inc.
ery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric .
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.

Hydrants.
The Flower Company.

Incinerators.
William F. Morse.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
Carey Co., Philip, The.
The Texas Company.

Kettles (Portable).
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machinery Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
The Barrett Co.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Co.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Federal Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
The Gramm-Bernstein Motor Truck Co.
International Motor Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Muhicipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros. Co.

Paving Joint Compound.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
The Barrett Co.
Carey Co., Philip, The.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Cummer & Son, The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L., The
Warren Bros. Co.

Pipe Cutters.
W. W. Stickler & Bros.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Mach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Powder (Blasting).
E. I. du Pont de Nemours & Co., Inc.

Tex., Pampa—City will construct water works and sewerage system. $80,000 bonds voted.

Va., Barton Heights (P. O. Richmond)—City has tentative plans for impvt. of sewers, streets, fire house, etc., $1,500,000 available. Stewart White, Councilman.

Wis., Milwaukee—Metropolitan sewerage commission considering plans for intercepting sewer for sewage of Whitefish Bay and Shorewood; also another to take care of W. Milwaukee and City of West Allis. Est. cost of two sewers, approx. $150,000.

Wis., Mukwonago—Contemplate water and sewer extens.: 3,800 ft. 4 and 6-in. cast-iron water mains; 12,800 ft. 6, 8 and 10-in. vit. sewers. G. Dillenbeck, Vil. Clk. W. G. Kirchoffer, Madison, Engr.

WATER SUPPLY AND PURIFICATION.

Cal., Pasadena—Municipal Water Dept. will lay 20-in. main on E. Colorado St. bet. Euclid and Mentor Aves. Est. cost $50,000.

Cal., San Diego—Hydr. Engr. H. N. Savage preparing detailed plans for work necessary to enlarge spillway at Morena dam. Est. cost of work $100,000.

Cal., Vernon—Howard McCurdy, 335 Pacific Elec. Bldg., Los Angeles, City Engr. of Vernon, has submitted to city trustees a report on new high pressure water sys. for industrial city adjoining Los Angeles. Est. cost $450,000. Bond issue will be submitted soon. Proj. will involve abt. 63,000 ft. cost iron pipe, 8, 10, 12, 14 and 16-in. diam.; approx. 2,908 tons pipe and 57 tons fittings; 100 gate valves and 205 fire hydrants. New well will be driven on city property at Vernon and Santa Fe Aves. and motor-driven turbine pump with capy. of 1,500 gals. per min. under 125 ft. head will be installed. There will be a 3,000,000 gal. reservoir, excav. and embank., 182x182 ft. at top and 16 ft. deep with 2 to 1 slopes lined with conc., reinf. with wire mesh; wooden roof; excav. abt. 2,700 cy. yards. 3 centrif. pumps, 1,250 gals. per min. operated by gas, motors, will pump water from reservoir into mains.

Que., Hull—$59,000 bonds voted here for extension of water works and sewer systems. T. Lanctot, City Engr.

Que., Montreal—Director of Pub. Wks. decided to recommend to executive committee the laying of a 48-in. water main from Pt. St. Charles Pumping Sta. to a point in vicinity of Place Viger Hotel, a dist. of abt. 2 miles.

Ont., Port Credit—Detailed plan of proposed water works sys., submitted to Town Council by Wm. Storrie of Gore Nasmith & Storrie, Cons. Engrs., Toronto. Est. cost $120,000. Plans approved by Provincial Bd. of Health.

Ont., Thornbury—Plans being prepared for new water works sys. $30,000. Prices wanted on pumps, pipe, etc. James, Proctor & Redfern, 36 Toronto St., Toronto, Engrs. These engineers also consultants on water works for Woodbridge, Ontario. Prices wanted on material and equipment.

Colo., Colo. Springs—Col. A. R. Humphreys, Denver, reported to be planning erection of a $100,000 water impvt. proj. on Goose Crk. above Wagon Wheel Gap.

Colo., Grand Jct.—Specfs. and estimates being prepared for new water works impvts., including new reservoir . Est. cost $150,000. G. Garrett, City Mgr.

Colo., Oak Crk.—City planning to constr. new water works storage reservoir on Oak Creek. Modern filtr. sys. will also be installed. Plans to be prepared by Chas. Vail, Engr. of State Pub. Utilities Comn. G. F. Watt, Mayor.

Ia., Marshalltown—City contemplates constr. of water plant. Alvord & Burdick, 8 S. Dearborn St., Chicago, Cons. Engrs. $355,000. Anne McMahon, City Clk.

Ia., Oskaloosa—$230,000 bonds carried for purch. of water works plant; $70,000 for water works impvts. and $370,000 for hydro-elec. development on Des Moines River.

Kans., Hutchinson—City considering purchase of water works of United Water, Gas & Elec. Co. No date set for bond election by the people. In meantime, however, City has reached agreement with Company that latter is to install new mains and pumping station to extent of $150,000 at once and to improve the service. Agreement also includes provision for establishment of water mains under 13 blks. of new pavement which is to be built at once. Mains will also be built and pressure maintained, to some of the industries which have insufficient service at present.

La., Cedar Grove—City will construct water works, sewer systems and street impvts. $125,000 water bonds voted; $100,000 sewer and $62,500 street bonds.

La., Winnsboro—Town will construct water works plant, install pumping plant, 100,000-gal. capy. $45,000. Kramer Engrg. Co., Magnolia, Miss., Engrs.

Me., Auburn—City will soon take bids for main extension from Lake Auburn pumping station, 12,000 tons cast iron pipe. A. W. P. Cobb, Clk., Water Comn.

Md., Baltimore—Architectural Comn. has selected Wm. W. Emmart, 1101 Union Trust Bldg., as Archt. for filtration plant at Montebello. $1,000,000. Est. to treat 90,000,000 gals. of water.

Md., McCalls Ferry—United Gas & Elec. Corp. (main office New York) E. G. Gonette, Pres.; Francis T. Homer, Baltimore, reported to develop hydro-elec. plant on Susquehanna River bet. tidewater and plant of Penn. Water & Power Co., at Holtwood. About $1,360,000 invested. Constr. work will probably start in February, 1st dam to be built near Conowingo.

Minn., Lake City—Considering laying water mains in abt. 85 blks. 32,000 lin. ft. 6 in. and 750 lin. ft. 4 in. cast iron pipe, etc. $50,000. L. P. Wolff, 1000 Guardian Life Bldg., St. Paul, Engr.

Minn., Winsted—Jno. W. Schaffer & Co., 917 New York Life Bldg., Minneapolis, has made survey for water works system. Est. cost of impvt. $50,000. Maturity indef. Fred Rouf, Clk.

N. C., Lexington—Bonds to amount of $300,000 have been sold for constr. of water and sewer systems.

N. C., Winston Salem—Engrg. Div. of Dept. Pub. Wks. will ask for bids within next 30 days for extensive impvts. to water plant; install 6 filters, constr. coagulating basin, wash tower, etc., install aerator, etc.

Ohio, Barberton—J. N. Chester, Engrs., Union Bank Bldg., Pittsburgh, Pa., retained by City to prepare plans and specfs. for an iron removal plant; also to make an investigation and report on the water supply.

Okla., Tulsa—Bids will be opened in Summer for $6,800,000 water supply project. J. D. Trammell, Cons. Engr., Ft. Worth, Tex.

R. I., Cent. Falls—Town considering impvt. and extension of water pipe system. $150,000. S. P. Cummings, City Engr.

Tex., Lamesa—Plans being prepared by Elrod Engrg. Co., Interurban Bldg., Dallas, for water works impvts. $60,000. M. H. Horton, City Secy.

Tex., Pampa—$80,000 bonds voted for installation of water works and sewer systems.

Va., Ashland—Extension of water and sewer system at cost of $70,000, being considered.

Wn., Puyallup—$75,000 bonds voted by City to replace water works system, iron or wood pipe. O. C. Gregory, Engr.

Wn., Tacoma—City expects to replace 30-in. wooden main in So. Cushman Dist .with 20-in. cast iron pipe. Est. cost $84,550. E. C. Manley, City Engr.

Wn., Walla Walla—Engr. E. B. Hussey, Alaska Bldg., Seattle, reports completion of plans and specfs. for Div. No. 2 of water works extension program. Div. No. 2 of the development will necessitate expendt. of about $140,000. Work will include constr. of 4-mile, 20-in. pipe line into the Wenaha national forest to tap purer water supply, constr. of gravity type dam 100 ft. wide and 16 ft. high, constr. of sluice gates, telephone pole line and wagon road into intake.

Wis., Rice Lake—Water works extensions and impvts. planned. Est. cost $40,000. O. Jenson, Clk. Engr. not selected.

Wis., Sturgeon Bay—City Council agreed on plan to drill well on top of Garland St. hill, erect 500,000 gal. reservoir and extend water mains down Garland St. to connect with mains in other parts of City. First move will be to call for bids for sinking 10 in. well deep enough to secure the water. Est. cost of this impvt. $3,000. Cost of reservoir estimated at bet. $40,000 and $50,000.

Wyo., Basin—At recent election it was voted to issue $60,000 bonds for water works impvts.

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